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CONTENTS.

An Asterisk (*) denotes an illustrated article.

OFFICIAL NOTICES—
- Thirty-fifth Annual Meeting, New England Association of Gas Engineers 241
- Wrinkle Department, Ohio Gas Light Association 241
- Novelty Advertising and New Business Department, Ohio Gas-Light Association 241

EDITORIALS—
- Briefly Told 242
  Moving in the Matter of Federation—Death of Mr. George W. Farnham.
- *How to Design a Roof Principal, by Mr. C. E. Teasdale 242
- Another Works' Contract that will Interest Gas Engineers—Concluded from Page 210 244
- *Efficiency Test of a Direct-Connected Steam Turbine Fan Blower Set, by Mr. C. R. Waller 244
- The Technical School and the University, by Mr. H. M. Howe 247
- The Dry Mixture of Cement, by Mr. A. L. Goetzmann 248
- The Successful Joint Utilization of Several Small Water Powers, by Mr. W. B. Jackson 250
- Specialization in Manufacture, by Mr. A. E. Outerbridge, Jr 251
- ITEMS OF INTEREST FROM VARIOUS LOCALITIES 252
  The Galveston (Tex.) Company's Officers—Mr. B. S. Pedersen Succeeds the Late Mr. Axel Gutsch—Annual Meeting, St. Paul, Minn.—Eastern Offices of the Mueller Mfg. Co.—Proposing a Gas Commission for Connecticut—Again Moving for a Plant at Ludington, Mich.—Two Annual Meetings—A Good Description of the Junker Calorimeter—Waste of Natural Gas in Southern Kansas—Death of Mr. A. A. Howlett—The Bergen County (N. J.) Company Taken Over—Annual Meeting, Laramie, Wyo.—Annual Meeting, Marshall, Mich.—Death of Mr. George W. Farnham—Another Connecticut Bill—Mr. J. F. Ryan Succeeds Mr. James L. McDonald—Mr. George Wilhelm Goes to Palmyra, N. Y.—Sale of the Haverstraw (N. Y.) Plant—And Other Items.
- The Market for Gas Securities 254

[OFFICIAL NOTICE.]

Thirty-fifth Annual Meeting, New England Association of Gas Engineers.

NEW ENGLAND ASSOCIATION OF GAS ENGINEERS,
EAST BOSTON, MASS., Feb. 1, 1905.

To the Members of the New England Association of Gas Engineers:

The Thirty-fifth annual meeting of the New England Association of Gas Engineers will be held at Young's Hotel, Boston, Wednesday and Thursday, February 15th and 16th, 1905.

Papers and topics will be presented on the following subjects:

"Some Practical Record Sheets;" by Mr. W. L. Walker, Fitchburg, Mass.

"Gas Mantles and Gas Mantle Lamps from a Commercial Standpoint;" by Mr. W. R. Addicks, New York.

"Accidents to Gasholders and Tanks;" by Mr. C. H. Corbett, Brooklyn, N. Y.

"The Relations of Firebrick Material to Retort House Construction;" by Mr. H. A. Carpenter, Pittsburg, Pa.

"Ammonia;" by Mr. D. D. Barnum, Worcester, Mass.

"Working with Deep Purifiers;" by Mr. C. H. Gifford, New Bedford, Mass.

"The Tar Situation;" by (?).

"Connecting Telephone Wires to Gas Piping;" by Mr. E. H. Yorke.

QUESTION BOX.

"Should gas companies favor setting all prepay meters to the exclusion of plain meters?"

"How can naphthaline be prevented from forming?"

"How can it be disposed of in street mains?"

"How are the mechanical devices for handling coal, hot coke, oxide, ashes, etc., working?"

"Can we co-operate in the sale of our tar?"

"How can the house governor nuisance be controlled?"

"What is the specific heat of tar?"

"What is the yield of ammoniacal liquor in ounce gallons per gross ton of coal?"

"What is the average strength and quantity of ammoniacal liquor per gross ton of coal collected at each of the several condensers and scrubbers in the cooling and washing system?"

Members are urged to send in any other questions they wish discussed, that they may be assigned to someone for answer. The annual banquet will be served Wednesday evening. Application blanks for membership may be had of the Secretary. The Proceedings of the Association, for the years 1897 to 1903 inclusive, are now in print and duplicate copies are for sale. Large additions have been made to the Library, in Room 715, Tremont Temple, and members are urged to visit the room and see how they may avail themselves of its privileges.

All friends of the Association are cordially invited to attend the meeting, whether receiving a formal invitation or not.

N. W. GIFFORD, Secretary.

SMITHSONIAN DEPOSIT
FEB 13 1905
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[OFFICIAL NOTICE.]

Wrinkle Department, Ohio Gas Light Association.

OHIO GAS LIGHT ASSOCIATION,
OFFICE OF SECRETARY,
DELAWARE, O., Nov. 21, 1904.

The Editor of the Wrinkle Department, Mr. E. E. Eysenbach, General Manager of the Binghamton (N. Y.) Gas Company, earnestly solicits the co-operation of the fraternity for contributions to be presented to the Twenty-first Annual Meeting of the Association, which is to be held at the Hotel Schenley, Pittsburg, Pa., March 15th, 16th and 17th, 1905.

Editor Eysenbach will be pleased to receive contributions not later than February 10th. Work for the good of the cause and send him your "Wrinkles."

T. C. JONES, Secretary.

[OFFICIAL NOTICE.]

Novelty Advertising and New Business Methods Department, Ohio Gas Light Association.

SECRETARY'S OFFICE,
DELAWARE, O., January 16, 1905.

The Editor of the Novelty Advertising and New Business Methods Department, Mr. B. W. Perkins, of South Bend, Ind., desires to announce that his department is now open for contributions to be pre-

sented at the Twenty-first Annual Meeting, which is to be held at the Hotel Schenley, Pittsburg, Pa., March 15th, 16th and 17th, 1905.

The sale of gas is one of the most important branches of our industry and this department is one of the most attractive features of the convention. It is, therefore, earnestly hoped that the fraternity will heartily co-operate with Mr. Perkins, and send him advertising and new business method schemes. T. C. JONES, Secretary.

BRIEFLY TOLD.

MOVING IN THE MATTER OF FEDERATION.—"The Hotel Astor on Long Acre Square (we cannot bring ourselves to call it any other name), on February 7th and 8th, presented the appearance that rules during the holding of a Gas Convention. The committee, consisting of 24, appointed to represent the different organizations of gas men throughout the United States met to discuss plans for the possible formation of one National Gas Institution. The idea prevails very generally that we have too many gas associations with large memberships which are national in character although the names would not imply that such was the case. This committee was the outcome of the Gas Congress, held in St. Louis, June, 1904. Our readers will remember that the sentiment expressed in voting was very much in favor of a merger which would place meetings of gas engineers and managers on a par or in advance of any other federation of engineering societies in this country. With this in view the following committee was appointed from the different gas associations—the three delegates at large were Messrs. W. R. Addicks, of New York; Walton Clark, of Philadelphia, and H. L. Doherty, of Denver:

"American Association, Wm. McDonald, F. H. Shelton. Guild of Gas Managers, W. A. Wood, C. F. Prichard. Kansas, Samuel Scoville, J. A. Bendure. Michigan, H. W. Douglas, B. C. Cobb. New England, Chas. D. Lamson, N. W. Gifford. Ohio, John D. McIlhenny, B. W. Perkins. Pacific Coast, E. C. Jones, John Martin, alternate, John A. Britton. Society of Gas Lighting, C. J. R. Humphreys, Geo. G. Ramsdell. Western Gas Association, Donald McDonald, Paul Doty. Wisconsin, H. H. Hyde, E. G. Cowdery.

"At the meeting all of the committee were in attendance except Messrs. W. A. Wood, Samuel Scoville, J. A. Bendure, N. W. Gifford and B. W. Perkins. Also among the absentees were Messrs. E. C. Jones and John A. Britton, but they were represented by Mr. John Martin, of San Francisco, who held their proxies. The unanimous opinion prevailed that a distinct plan for a merger must be presented before anything definite could be arranged. A committee of six, consisting of Messrs. F. H. Shelton, W. R. Addicks, Walton Clark, H. L. Doherty, Donald McDonald, of Louisville, Ky., and Wm. A. McDonald, of Albany, N. Y., were elected to draft a plan and specifications which can be presented to the different Associations. The committee adjourned on the 8th, subject to call of the permanent Chairman. The committee elected the following officers: Mr. F. H. Shelton, Chairman; Mr. A. E. Forstall, Secretary; Mr. Wm. A. McDonald, Treasurer. At the close of the meeting the committee were handsomely entertained by the Society of Gas Lighting, the entertainment consisting of an elaborate and well served dinner given at the Hotel Astor.—F."

DEATH OF MR. GEORGE W. FARNHAM.—Our current item columns contain mention of the death of Mr. George W. Farnham, of Lowell, Mass., and since that mention was made we are indebted to a correspondent, who knew him long and respected him well, for the following: "Mr. George W. Farnham, formerly Superintendent of the Lowell (Mass.) Gas Light Company, died Sunday, the 5th inst. He was born in New Hampton, N. H., January 17th, 1835, and entered the employ of the Lowell Gas Light Company when in his 18th year. He remained with the Company for 52 years, in varying capacities. In 1893 he was appointed its Superintendent, succeeding the late Mr. Oliver Cushing. The positions that he held were filled to the satisfaction of all concerned, until failing health obliged him to assume a position in the Company's service that did not require so active a part in fulfilling its duties. He gave to the engineering world the sight-feed, cylinder oil cup, of which device he was the inventor. In this he sold his interest to the Siebert Cylinder Oil Cup Company, of Boston, which concern for some years controlled its manufacture. He was a man of sterling worth; upright, honest and faithful to his employers' interests to a marked degree. His wife and one daughter survive him. The funeral was held Wednesday, the 8th inst., and in attendance thereon were many representatives from the New England Association of Gas Engineers and the Guild of Gas Managers, both bodies contributing floral tokens of beauty to the memory of their dead.

How to Design a Roof Principal.

[From a paper read by MR. C. E. TEASDALE, at the last meeting of the Manchester District Junior Gas Association, Manchester, England.]

The author, by way of preface, said he had designedly altered the primal naming of his paper, from the title of "Roofs" to the one sent in, for he found that the original subject in scope required greater time for proper presentation than he could spare. Accordingly, as he had been requested by the Council to give a paper on this subject, he had chosen the above, as it was the most important part. If one could design the principal, the rest was an easy matter. He then went on to say: For the purpose of the paper, the principal to design is one of 58-foot span, with an over-all dimension of 60 feet; thus giving 1 foot bearing with a wall at either side with principals set at 9-foot centers. The first thing to ascertain is the load acting on each principal. The loads on a roof are partly permanent and partly occasional. The greatest natural load which can come on a roof is when it is covered with snow; and the greatest pressure when one-half of it is exposed to a violent gale. The permanent load consists of the weight of slates, the purlins, the louvres, and all the framework; while the occasional load consists of the maximum snow or wind pressure to which the roof may be subjected. For the permanent load take 9 pounds per square foot for the structure, which includes all framework and purlins, and for the slates take 5 pounds per square foot; for the occasional or accidental load take 36 pounds per square foot area normal to the surface of the roof as the maximum wind pressure. The weight of snow is usually disregarded in this country, on the supposition that it is not likely to happen at the same time as the maximum wind pressure. According to Mr. Glaisher, during a period of 20 years at the Royal Observatory, the greatest wind pressure was recorded as blowing from east to west—equal to 28 pounds per square foot. The highest wind pressure in the country has been 55 pounds per square foot blowing in a horizontal direction; but the maximum wind pressure is taken as 50 pounds per square foot of vertical surface. The ordinary direction of the wind is horizontal, or nearly so; but as fluid pressure is always exerted at right angles to the surface upon which it acts, so with the wind, which acts normal to the surface of the roof. Therefore the horizontal force must be resolved into a force acting vertically with the slope of the roof. Taking 50 pounds per square foot as acting on the surface perpendicular to the direction of the wind, and multiplying by 0.66, the tabular number, by Unwin's formula, for a roof of over 30° pitch, as adopted in the present case, we have $50 \times 0.66 = 36$ pounds per square foot acting normal to the surface; and we have a total load per square foot of—

Structure	9 pounds.
States	5 "
Wind pressure	36 "
	56 "

Then we have a total load on one principal of 50×34 feet 8 inches $\times 2 \times 9$ feet $= 31{,}194$ pounds $= 13.9$ tons—say 15 tons load.[1] The 34 feet 8 inches is the length of one rafter set 9 feet centers as shown in Fig. 1.

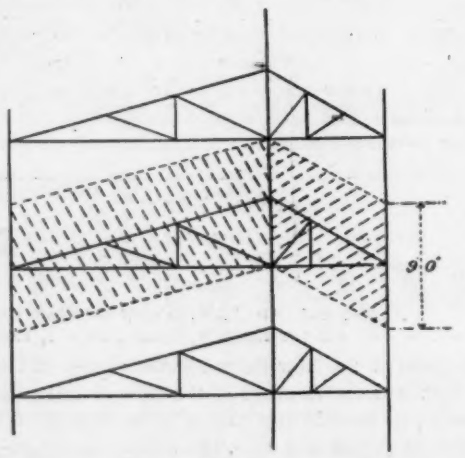


Fig. 1.

The shaded portion is the area supported by one principal—viz., each principal carries half the load in the portion of roof between it and the next truss. We then set out a line diagram of the principal of ap-

1, This 15 tons was taken in error in place of 14 tons.

proved design, as in Fig. 2, which is a style largely adopted in this

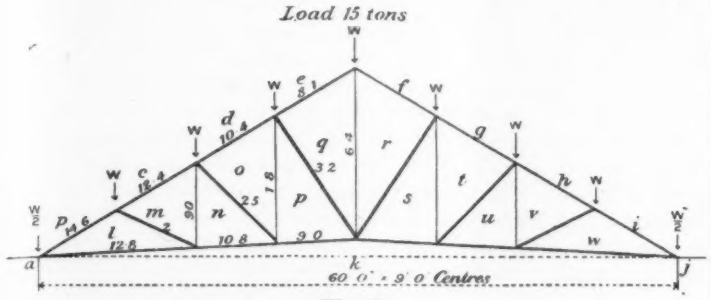


Fig. 2.

country. The method of apportioning the load, which is a distributed one, is— $\frac{\text{Load}}{\text{Number of bays}} = \text{W}$, or the load on each bay.

Therefore every bay, or that portion of the rafter between each joint, is like a girder supported at both ends, and bearing a distributed load; half the weight going to each support. Then on each intermediate joint we get a load W, and on each joint $\frac{\text{W}}{2}$, or half the load on a bay.

Having lettered the frame diagram according to Bow's notation—that is, each space bearing a letter, we proceed to make the strain diagram (Fig. 3.) First set down the vertical line $a\,j$ equal to the total

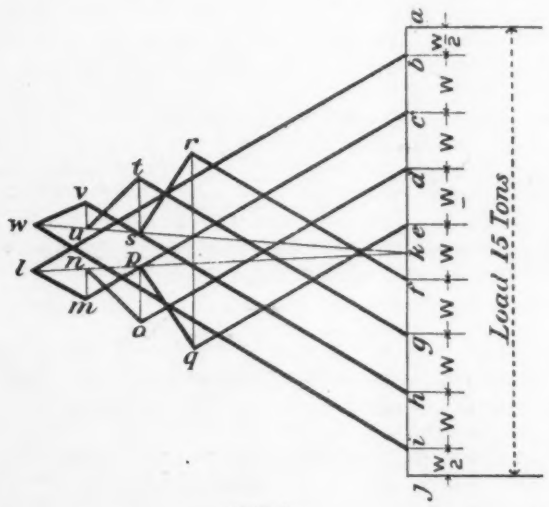


Fig. 3.

load, 15 tons, at a convenient scale say— 4 tons to an inch. Then, there being 8 bays, divide this into eight equal parts. One part being equal to W, from j and a set off half a part, $j\,i$ and $a\,b$, equal to $\frac{\text{W}}{2}$, and the other seven parts equal to W as $b\,c$, $c\,d$, $d\,e$, etc. From these points draw lines $b\,l$, $c\,m$, $d\,o$, and $e\,q$, parallel to the rafters, lines $l\,m$, $m\,n$, $n\,o$, $o\,p$, $p\,q$, and $q\,r$, parallel to the struts and tie-rods respectively, and lines $l\,k$, $n\,k$, and $p\,k$, parallel to the main tie-rods, and so on with the other half of the principal. These should form a diagram as shown; the lettered lines in the latter corresponding with the frame diagram. Then by scaling, the strains on any member can be obtained due to a load of 15 tons. For example, the load on that part of the rafter $b\,l$ as measured in the strain diagram is 14.6 tons, etc. The thick lines in the diagram denote the members in compression; the thin ones those in tension.

The rule for finding (according to Clerk Maxwell's system) whether a member is in compression or tension is as follows:

1. Read off the letters on either side of the member in question in the frame diagram in the order in which you meet them when revolving round either joint connected with that member in the direction employed for lettering the diagram.

2. Put an arrow on the corresponding line in the strain diagram pointing from the first letter to the second named above.

3. Transfer this direction back to the frame diagram. If the arrow points towards the joint, that member is in compression, but if it points away from the joint it is in tension. (N.B.—The direction of the arrow must only be taken to refer to the joint round which the revolution was made.)

Knowing the strain and the kind of force acting on the various members, we must find material of sufficient strength to withstand these forces. It is usual in roofs up to 60 feet span to use T-steel rafters and struts, and round steel bars for the tie-rods, 3½ tons per square inch for the rafters and 1½ tons for the struts. It has been found by practice that these are safe factors. If 6 tons were taken as the factor of safety throughout, the whole thing would be too flimsy; hence we put in much stronger struts and rafters to impart rigidity to the truss, and give them strength to resist any tendency to bend owing to the compression in that member. The maximum strain on the rafter is 14.6 tons. The area required is $\frac{14.6}{3.5} = 4.17$ square inches. The area of 4 × 4½ × ⅝ T.S. at the smallest section, that is, in this case, with one rivet deducted = 4.45 square inches; thus showing a margin in area—it being better to err on the excessive side. The following table shows the area required and the area adopted in the rafters and struts:

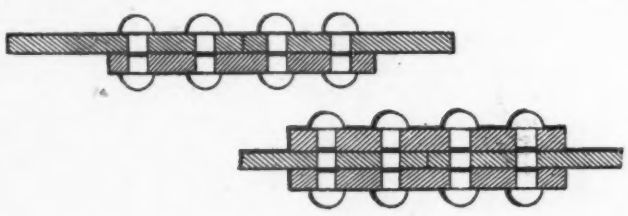
Member.	Strain as by Diagram.	Area Required. Square Inch.	Area Adopted. Sq. Inch *	Size of Bar.
p t rafter.....	maximum 14.6	4.17	4.45	4 × 4½ × ⅝ T.S.
l w "	" "	"	"	" " "
l m strut.....	" 2.0	1.33	1.87	3 × 3 × ⅜ T.S.
r w "	" "	"	"	" " "
n o "	" 2.5	1.66	1 87	" " "
t u "	" "	"	"	" " "
p q "	" 3.2	2.15	2.87	3½ × 3½ × ½ T.S.
p s "	" "	"	"	" " "

* The figures given include the deduction of the rivet or bolt hole as the case may be.

The strains, area required, and adopted in the tie-rods or those bars in tension, are shown in the following table; the factor of safety being 6 tons per square inch:

Member.	Strain as by Diagram.	Area Required. Square Inch.	Area Adopted. Square Inch.	Size of Bar.
l k.....	12.80	2.13	2.40	1¾-inch diameter.
w k	"	"	"	" "
n k.....	10.80	1.80	2.07	1½-inch "
u k.....	"	"	"	" "
p k.....	9.00	1.50	1.76	1¼-inch "
s k.....	"	"	"	" "
m n.....	0.90	0.15	0.44	¾-inch "
u v.....	"	"	"	" "
o p.....	1.80	0.30	0.78	1 -inch "
s t.....	"	"	"	" "
q p.....	6.40	1.06	1.48	1½-inch "

One thing that should be noticed in designing a roof principal is that the greater the rise given to the main tie-rods the greater the strain produced on the rafters. In designing the joints for the struts, tie-rods, etc., care must be taken that sufficient area is given in all cleat plates, rivets, bolts, etc., to withstand the strain acting on the member it secures. Consideration must be had as to whether the rivets are in single or in double shear. Rivets are said to be in single shear when only one joint plate is used, or a lap joint, and in double shear when



the two joint plates are used. The thick lines show clearly where the shearing force is executed. Therefore it is evident that a rivet in double shear is twice as strong as one in single shear; or to withstand the same strain, twice the number of rivets of the same area will be required in the first figure as in the second. Taking the factor of safety for rivets and bolts as 6 tons per square inch, then, for example, with a strain of 3.2 tons on the strut $p\,q$, the combined area of the two bolts, if they were in single shear, would be 3.26 ÷ 6 = say, 0.6 square inch; but as they are in double shear, the combined area required would be half the above—viz., 0.3 square inches. On the drawing, ¾-inch bolts are used, having a combined area of 0.88 square inch; thus being much stronger than required.

It is usual to brace large iron roofs diagonally, to enable them to re-

sist the effects of the wind blowing at an angle with the axis of the roof in an oblique direction. The principals are also stayed together by a tie-rod running longitudinally, fastened to each center plate, the size of which in the present case is figured as 1-inch diameter.

The crippling strain of a strut fixed at both ends can be obtained by Shaler Smith's formula, which is for a strut fixed perpendicularly. The same form will do for a sloping strut. When a bar is bent to such an extent that it exceeds its elasticity—that is to say, if a bar, after being bent, does not spring back, but has a permanent set—it is said to be crippled; hence the force to cripple the strut *l m* would have to be one of 25.4 tons, if the strut were acting vertically.

[Concluded from Page 210.]

Another Works' Contract that will Interest Gas Engineers.

A second contract that carries out original planning is shown in a novel design of coal-handling plant, constructed for the new gas works, St. Heliers, Jersey, England. The new retort house of the St. Helier's gas works, together with the plant for working the same, was designed by Mr. J. Morris, Engineer to the Company, the contractors being Messrs. Graham, Morton & Co., of Leeds. The installation has some novel features to commend it, and for our knowledge thereof we are indebted to the contractors. Our informants say: Starting with a general description of the work covered by the contract, we shall pass to more explicit details of the various portions of the plant and machinery. The contract included the supply and erection of the following:

A coal receiving hopper; a jigging screen; two 2-roll crushers; a 24-inch elevator, with 50-foot centers; 24-inch standard, push-plate conveyor, 142-foot centers, and the whole of the necessary structural work for carrying the plant; also, the supply of one 40-horse power steam engine and the requisite gearing for driving the installation.

From this general statement the writer may go on to narrate some details of the various divisions, together constituting the entire plant. Commencing with the receiving hopper, it is built up of $\frac{3}{16}$-inch steel plate, of the usual standard design, 7 feet 6 inches long, by 5 feet wide, by 3 feet 6 inches deep. It is supported on two 6-inch by 3-inch channels built into the walls of the crusher pit. Beneath the receiving hopper is placed a 2-roll crusher for breaking the coal, which subsequently passes over the jigging screen, from the larger of the crushers into the second or smaller one, which is an adjusting crusher, similar to the first, except that it reduces the coal into smaller pieces. The arrangement of the crushers, as intimated, is the outcome of the experience of Mr. Morris, the Gas Company's Engineer, who has had special opportunity of practically testing various designs of crushers. The novel feature of the Morris crusher is that it is made in two pieces, and so contrived that very large lumps of coal can be crushed without loss of capacity. The larger of the crushers is 4 feet by 3 feet, by 2 feet 4 inches, built up of $\frac{1}{2}$-inch steel side plates and $\frac{5}{16}$-inch end plates, provided with cast steel rollers. It is supported on 8-inch by 3-inch channels and on 10-inch by 5-inch rolled steel joists.

The plan of employing two crushers is to obviate the difficulty frequently experienced when the bottom rolls become choked with coal owing to small coal passing through in large quantities. The top rolls are of cast steel, 2 feet 8 inches in diameter and are of the claw type. They are mounted on 6-inch, square shafts, revolving in massive, cast iron brackets bushed with white metal. The size of coal with which the crusher is capable of dealing is about 2 feet 6 inches cube. Immediately under the crusher is arranged a small screen feeder—*i. e.*, jigging screen—which allows all the small coal to pass through the bars and delivers the same by means of a bye-pass shoot to the elevator boot, thence it is carried by the elevator (about which more shall be said presently) to the top of the coal stores, being then delivered to a 24-inch push-plate conveyor, running the full length of the interior of the former, whence it is distributed by 11 sliding doors to the floor of the coal store, passing thence as required to the retort house.

All the coal which is too large to pass the screen bars is delivered to the secondary crusher, to be crushed to the requisite size. This crusher, which is similar in design and construction to the primary one, is 3 feet 9 inches, by 3 feet 2 inches, and is supported on 8 inch by 3½-inch channels, and 10-inch by 5-inch rolled steel joists. It differs from the larger crusher in that one set of rolls is adjustable, so that any size of coal can be made.

A few details concerning the jigging screen, which is immediately under the primary crusher, will not be amiss. It is driven from a shaft by eccentrics, and is 4 feet 6 inches long, by 2 feet 7 inches wide, and 9 inches deep, built up of steel plates and angles. The screen is of the flat-bar type, the bars being bolted together to form the sieve, and arranged to afford facility of access. This screen is supported on two 6-inch by 3-inch steel channels. The crusher pit is covered in by means of $\frac{5}{16}$-inch checker plates, and a ladder is provided for the convenience of easy access to the pit.

Next comes the elevator, which is of the cased-in type, the boot being of cast iron. The body of the elevator is built up of angle runners, cased in with steel plate, and the capacity of the elevator is 50 tons of coal per hour. The elevator head is carried by means of 6-inch by 3-inch channels, and these are built into the wall of the coal store at one end and supported on beams at the other. The shoot from the elevator head is constructed of $\frac{3}{16}$-inch plate and connected to the push-plate conveyor. The buckets are of stamped steel, 24 inches wide, attached to two strands of 6-inch pitch chain, and fixed at every fourth link.

The push-plate conveyor is built up of 6-inch by 2½-inch and 3-inch by 3-inch angle iron runners, firmly braced together by means of angle irons and flat bars. The push-plates are pitched every 2 feet, and are attached to two strands of 6-inch pitch chain; the bottom of the trough is formed of ¼-inch plate, fixed to 6-inch by 2½-inch channels.

The conveyor is supported on 10 inch by 4½-inch rolled steel joists, 24 feet 3 inches above the floor level. The conveyor is provided with 11 sliding doors, the driving and trailing ends are built up of 4-inch by 2½-inch channels, placed in position back to back, supported on 6-inch by 3-inch channels and fitted with the necessary shafts and drums.

The whole of the plant is driven by one 40-brake horse power steam engine, which leaves a considerable surplus of power. The drive is by means of a belt on a cross shaft, from which the power is taken to drive the crushers and screen by means of additional belts, while, for driving the elevator and conveyor, it is carried by way of bevel wheels to a vertical shaft.

The gearing and belts for driving the entire plant were supplied by the contractors whose work was accomplished in complete compliance with the demands of their employers.

Efficiency Test of a Direct-Connected Steam Turbine Fan Blower Set.

By C. R. Waller.[1]

An efficiency test made recently in the testing room of the De Laval Steam Turbine Co., Trenton, N. J., on a direct-connected set consisting of a 20-horse power De Laval steam turbine and a Sturtevant gas blower, gives valuable information about the performance both of fan blowers and of steam turbines. A report of the tests is submitted in the following: The test is the more interesting because, in order to obtain the maximum discharge desired, it was necessary to run the turbine at nearly 50 per cent. overload. The machine stood this load perfectly well, though, of course, the steam consumption per unit of power was higher than for rated load.

The set consisted of a No. 7 special Sturtevant extra heavy gas blower, coupled direct to the gear shaft of a 20-horse power De Laval turbine. The turbine shaft ran at 20,000 r. p. m., the gear and blower shaft at 2,000 r. p. m. Blower and turbine were mounted on the same bed plate. The blower was designed to run at the speed actually used, viz.: 2,000 r. p. m. Its impeller is 29½ inches in diameter and is of the inclosed type, with curved blades (see Fig. 4).

The purpose of the test was to determine the characteristic pressure discharge curve of the blower, and the steam consumption of the set per air horse power delivered. Specifically, the quantities to be determined were:

1. The pressure produced by the blower at constant speed. 2. The amount of air discharged. 3. From the preceding items the air horse power (A.H.P.) and the characteristic curve of the blower. 4. The steam consumption of the set per A.H.P., and the efficiency of the blower. The last named item involved a knowledge of the performance of the turbine itself at various loads. This was obtained by separate break test.

In order to measure pressure and volume of the air discharged, a wooden box 48 × 42 × 52 inches was constructed and connected to the discharge opening of the blower. On top of the box a circular opening was made, over which converging air nozzles of different sizes could be placed. In front of the opening a Pitot tube of small diameter, and

1. Assistant Engineer, De Laval Steam Turbine Co., Trenton, N. J.

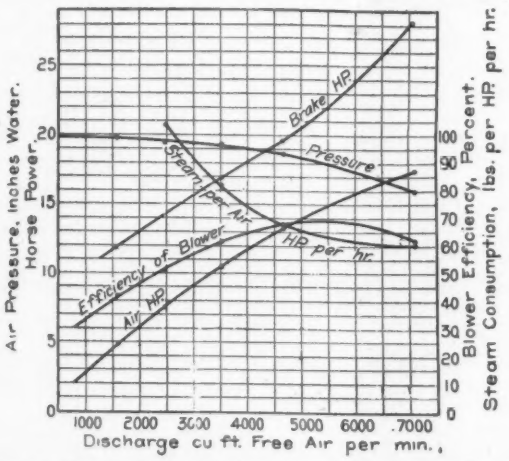


Fig. 1.—Diagram of Results of Test of 20 Horse Power De Laval Steam Turbine Blower Set.

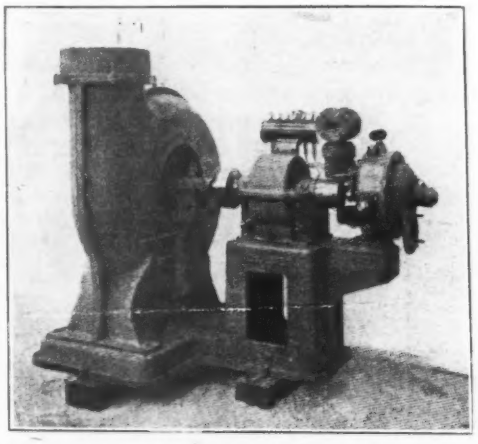


Fig. 2.—View of 15-Horse Power SIngle-Geared Steam Turbine Blower Set.

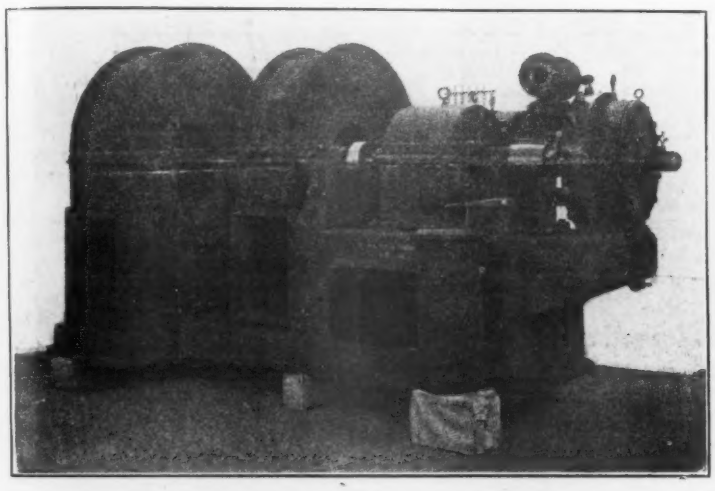


Fig. 3.—Double Geared Sirocco Blower Set of 150-Horse Power.

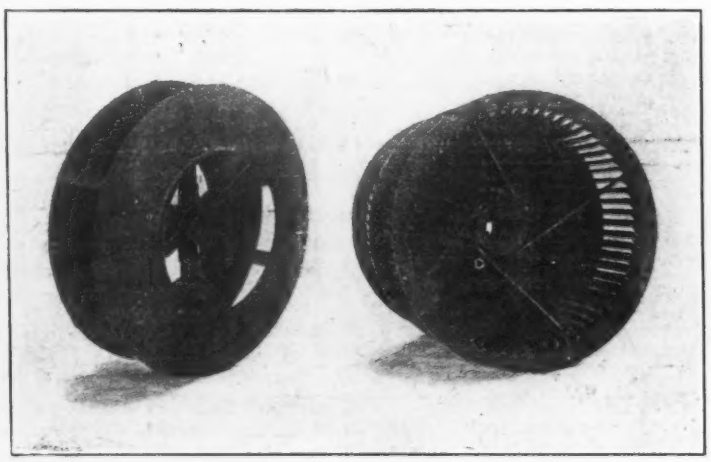


Fig. 4.—Impellers of Sturtevant and Sirrocco Blowers.

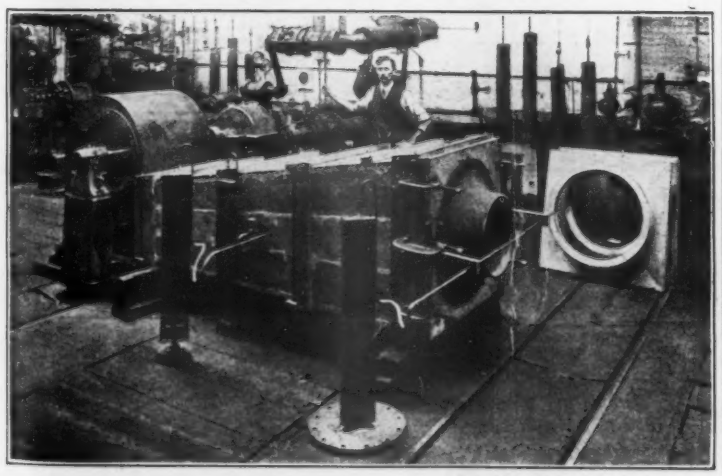


Fig. 5.—Arrangement of Apparatus for Efficiency Test of a Steam Turbine Sirocco Blower Set.

connected to a water gauge, was attached, in such way that its receiving end, flush with the discharge edge of the nozzle, could be swung across the whole diameter of the nozzle. This was done in all the various tests; the variations in the Pitot gauge reading at various points of the nozzle were noted, and an average value determined The readings at the Pilot tube gauge registered the head due to the discharge velocity in the nozzle, and from this the discharge could be computed.

The pressure produced by the blower was ascertained by means of a water gas gauge connected to the box in a place where it was reasonable to suppose that the readings would not be influenced by the velocity of the air.

Six separate tests were made, five with the blower discharging through nozzles, respectively, 4, 5, 6, 7 and 9 inches in diameter, the sixth test being made with the nozzle entirely shut off.

Besides the readings of the pressure and Pitot tube gauge, the following observations were taken during each test:

The pressure of the atmosphere.

The temperature, relative humidity of the air, and vapor pressure, by means of a wet and dry bulb thermometer.

The temperature in the air box.

The steam pressure above and below the governor valve in the steam supply pipe.

The temperature of the steam.

The speed of the blower.

The steam consumption.

This latter was determined by means of a nozzle test, wherein a nozzle of the same shape and size as those used in the turbine was connected to the turbine wheel case by means of a pipe through which steam was discharged into a barrel of water placed on a scale. Between this nozzle and the barrel, a steam gauge and a 3-way cock were placed, the former to ascertain that the pressure on the discharge side of the nozzle at all times was below 58 per cent. of the pressure in the wheel case. This pressure at no time rose above 43 pounds, thus satisfying the requirements of an accurate test. The 3-way cock was set, immediately before the test, to discharge the steam into the atmosphere, so as to remove all condensation in the pipes; then quickly turned to admit the steam into the barrel. The time during which the steam was discharged into the barrel was carefully noted, and the weight of the water in the barrel was taken before and after the discharge. The difference in these weights then gave the total steam consumption per nozzle for the duration of the nozzle test, which was 3 minutes for each test.

As the purpose of the work was to make a thorough test of the blower, steam nozzles were provided sufficient to overload the turbine greatly. This effect has already been noted.

The brake horse power of the turbine was determined in the following manner: After the blower was tested, it was removed and a Prony brake substituted, which was loaded until the steam gauge below the governor valve registered the same pressure as during any one of the blower tests. The speed and number of turbine nozzles open were also adjusted to the conditions existing during each of the blower tests. This method of obtaining the brake horse power and the efficiency of the blower was similar to that employed by Professors Kent and Denton recently when testing a number of De Laval centrifugal pumps at these works. Since nozzles under the conditions of these tests are very accurate steam

Performance Tests of 20-Horse Power De Laval Steam Turbine and Sturtevant Blower, No. 7 Special.

Time of Test.	Steam Pressure at Governor Valve in Pounds. Above.	Below.	Temparature of Steam. Deg. F.	Total Steam Used by Turbine. Pounds per Hour.	Speed of Gear Shafe per Min.	Steam Nozzles No. Open	Psychrocrometer Readings, Temperature in Deg. F. Wet.	Dry.	Temperature of Air in Box. Deg. F.	Barometer Pressure. Inches.	Diameter of Air Nozzle. Inches.	Pressure. Ins. Water. Air Box.	Pitot Gauge.	Quantity of Air Discharged in Cubic Feet per Minute. Formula.	Pitot Read.	Air, Horse Power. Formula.	Pitot Read.	Brake Horse Power.	Efficiency of Blower. Per Cent. Formula.	Pitot Read.	Steam Used per Air H.P. Hour. Form.	Pitot Read
Test No. I.—4-Inch Air Nozzle.																						
4.45	101.75	59.25	....	....	2,010	...	73.0	86.5	....	.....	...	19 1/8	19 1/8	.....	.....	...	....	.....	.. .	... .	....	.....
.50	101.75	58.3	....	....	2,020	...	72.5	86.0	....	.....	....	19 3/16	19 3/16	.....	.....	...	....	.....	.....	.....	..	.....
.55	101.75	59.25	....	....	2,015	...	72.7	86.5	....	.....	....	19 3/16	19 3/16	.....	.....	...	....	.....	.....	.....	..	.....
5.00	101.75	....	....	....	.....	...	....	....	...	.....	....	.....	.....	.....	.....	....	....	.....	.....	.....	...	.....
Aver..	101.75	58.75	335.5	752	2,015	2.5	72.9	86.5	98.6	29.91	4 in.	19.78	19.85	1,584.7	1,585	4.87	4.88	11.625	41.89	41.97	154	153.8
Test No. II.—5-Inch Air Nozzle.																						
2.20	101.75	65.5	....	....	2,020	...	76.0	87.5	....	29.91	....	19 1/8	19 1/8	.....	....	....	....	.....	.....	.....	....	.....
.25	101.75	65.0	....	....	2,025	...	75.0	88.5	....	.....	....	19 1/8	19 1/8	....	....	....	....	.....	.....	.....	....	.....
.30	101.75	64.5	....	....	2,022	...	75.0	88.0	....	.....	....	19 7/16	19 1/8	.....	....	....	....	.....	.....	.....	....	.....
.35	101.75	64.5	....	....	2,021	...	75.4	88.0	....	.....	....	19 7/16	19 1/8	.....	....	...	....	.....	.....	.....	....	.....
.40	101.75	64.5	....	....	2,025	...	76.0	88.0	....	.....	....	19 1/8	19 7/16	.....	..	..	....	....	.....	.....	....	.....
Aver..	101.75	64.5	351	810	2,023	2.5	76.0	88.0	100	29.91	5 in.	19.47	19.4375	2,475.9	2,456.2	7.63	7.51	14.625	51.17	51.35	106	107.8
Test No. III.—6-Inch Air Nozzle.																						
3.25	101.75	68.75	.	....	2,030	...	74.0	88.0	....	.....	....	19 1/16	18 7/8	.....	....	....	....	.....	.....	.....	....	.....
.30	101 75	68.75	....	....	2,028	...	73.5	87.5	....	.....	....	19	18 3/16	.....	....	....	....	.....	.....	.....	..	.....
.35	101.75	68.75	. ..	....	2,035	...	73.0	87.6	....	.....	...	19	18 3/16	.....	....	....	....	.....	.....	.....	....	.....
.40	101.75	68.75	....	....	2,009	...	72.7	87.0	...	.....	....	19	18 3/16	.....	....	....	....	.....	.....	.....	....	.....
.45	101.75	68.75	....		2,040	...	72.5	87.0	....	.....	....	19	18 7/8	.....	....	....	....	.....	.....	.....	....	.....
Aver..	101.75	68.75	343	854	2,033	2.5	72.9	87.4	100	29.9	6 in.	19.31	13.845	3,511 7	3,512.9	10.42	10.43	16 875	61.7	61.8	81.9	81.7
Test No. IV.—7-Inch Air Nozzle.																						
4.05	101.75	74.7	....	....	2,042	...	72.0	86.5	....	.....	....	18 1/8	18 5/16	.....	....	....	....	.....	.....	.....	....	.....
.10	101.75	74.2	....	....	2,042	...	72.5	87 0	.. .	.....	....	18 5/16	18 1/8	.....	....	....	....	.....	.....	.....	....	.....
.15	101.75	74.2	....	....	2,045	...	72.5	87.0	....	....	....	18 1/32	18 1/8	.....	....	...	....	.....	.....	.....	....	.....
.20	101.75	73.7	....	....	2,040	...	73.2	87.5	....	.....	....	18 1/32	18 1/8	.....	....	....	....	.....	.....	.....	....	.....
.25	101.75	73.7	....	....	2,042	...	73.0	87.7	....	.....	....	18 5/16	18 1/16	.....	....	....	....	.....	.....	.....	....	.....
Aver..	101.75	74.0	348	906	2,042	2.5	72.65	87.15	100	.....	7 in.	18.71	18.175	4,656.9	4,659.0	13.3	13.38	19.625	67.8	68.2	68.1	67.7
Test No. V.—9-Inch Air Nozzle.																						
9.25	101.75	90.0	....	....	1,980	...	74.5	82.5	....	.....	....	16 7/32	15 1/8	.....	....	....	....	.....	.....	.....	....	.....
.30	101.75	90.75	....	....	1,990	...	73.3	83.3	....	.....	....	16 1/32	15 1/16	.....	....	....	....	.....	... .	.....	...	.....
.35	101.75	90.75	....	....	1,990	...	74 0	83.0	....	.....	....	16 1/32	15 1/16	.....	....	....	....	.....	.....	.....	....	.....
.40	101.75	90.0	....	.. .	1,995	...	73.7	83.7	....	.....	....	16	15 1/16	.....	....	....	..	.....	.....	.....	..	.....
.45	101.75	80.7	....	....	1,995	...	75.0	83.7	....	.....	....	15 31/32	15 1/16	.....	....	....	....	.....	.....	.....	....	.....
.50	101 75	89.7	....	....	1,975	...	73.7	83.7	....	.....	....	15 15/16	15 1/8	.....	....	....	....	.....	.....	.....	....	.....
Aver..	101.75	90.0	335.4	1,065	1,990	2.5	74.2	83.5	93.8	30.02	9 in.	15.988	15.625	7,051.7	7,100.0	17.1	17.5	28.06	61.2	62.3	62.2	60.8
Test No. VI.—Discharge Outlet Closed.																						
			51.2	335.5	2,053	2.5			93.8			19.875	No discharge.									

Steam nozzles used: No. 2, diameter = .327 inch. No. 5, diameter = .382 inch Turbine was run non-condensing.

Note.—Tests made September 26 and 27, 1904, at works of De Daval Steam Turbine Co , Trenton, N J.

meters, the quantities of steam corresponding to the measured brake horse powers could be determined by comparison with the steam pressures in the fan tests.

Calculation of Results.—In order to obtain accurate results for comparison when testing blowers, it is particularly necessary to make observations of the atmospheric pressure and temperature of the air, and also of the moisture it contains, although under ordinary conditions of the atmosphere the latter will not affect the results very materially.

The weight of 1 cubic foot of air is dependent upon the atmospheric pressure, temperature and moisture, and is:

$$W = \frac{0.0807\ (p - 0.379\ h\ e)}{(1 + a\ t)\ 29.921}$$

where:

0.0807 = the weight of 1 cubic foot of dry air at 32° and at a normal atmospheric pressure of 29.921 inches.

0.379 = the percentage of vapor contained in 1 pound of saturated air at 32°.

p = the atmospheric pressure.

h = the relative humidity.

e = vapor pressure.

(1 + *a* t) = the volumetric ratio of dry air at temperature (32 + t) degrees F. to air at 32° F.

Thus, for Test IV., where the dry and wet bulb thermometer gives H = 0.49, e = 1.287, t = 55.15, and p = 29.91, we have:

$$W = \frac{0.0807\ (29.91 - 0.49 \times 1.287 \times 0.379)}{1.11245 \times 29.921} = 0.0721 \text{ pound.}$$

The velocity of discharge is $V = \sqrt{2gH}$ feet per second, H being the head in air column derived from the Pitot gauge reading and W, and equal to the weight of 1 cubic foot of water divided by the weight of air and multiplied by the Pitot gauge reading in feet; thus:

$$H = \frac{62.355}{0.0721} \times 1.514 = 1{,}309.3, \text{ and}$$

$$V = \sqrt{2 \times 32.18 \times 1{,}309.3} = 290.29 \text{ feet per second.}$$

The amount of air discharged per second is

Q = c A V.

A = area of nozzle in square feet.

c = a constant for the nozzle. This constant is given by Weisbach and Grashof as 0.97 for a converging nozzle ¾ inch in diameter. As this constant undoubtedly varies with the diameter of the nozzle, approaching 1 with increasing diameter, and as it is always difficult to determine, the test is simplified if this constant is set at 1, as has been done here.

Then for Test IV. we have Q = .2672 × 290.29 = 77.65 cubic feet per second, or 4,659 cubic feet per minute.

The work expended upon the air is equal to the work done by the expanding air; thus:

$H = \frac{V^2}{2g}$ foot pounds, and the air horse power when discharging Q cubic feet per second is:

$$\text{A.H.P.} = \frac{W\ Q\ H}{550} = \frac{W\ Q\ V^2}{1{,}100g}$$

For the case of Test IV. this gives

$$\text{A.H.P.} = \frac{0.0721 \times 77.65 \times 290.29^2}{2g \times 550} = 13.38.$$

The brake horse power corresponding to the conditions of Test IV.

was found to be 19.625: thus the efficiency of the blower: E = 13.38 ÷ 19.625 = 68.2 per cent. The total steam consumption was 906 pounds per hour, and the steam consumption per air horse power is 67.7 pounds per hour.

The following formula for the velocity of discharge from a nozzle affords a check on the Pitot method:

$$V = \sqrt{2g \frac{n}{n-1} p_o v_o \left[\left(\frac{p}{p_o}\right)^{\left(\frac{n-1}{n}\right)} - 1. \right]}$$

$g = 32.18$ feet per second.
p_o = pressure of air outside box in pounds per square foot.
v^o = specific volume of air at pressure p_o.
p = equal pressure of air in box in pounds per square foot.
$n = 1.41$.

Following is a comparison of the results of the two methods for determining V:

Number of Test.	Velocity of Air at Nozzle. From Formula.	From Pitot Reading.
I.....	302.55 feet.	302.60 feet.
II.....	302.20 "	301.00 "
III.....	297.10 "	297.20 "
IV.....	290.15 "	290.29 "
V.....	265.90 "	268.10 "

This sufficiently demonstrates the reliability of either of the two methods for determining V. The curve sheet, Fig. 1, shows the results only as calculated from the Pitot tube readings, but in the table are also given the results calculated from the formula for V.

The results of the six tests are given in the accompanying table, and in diagram form in Fig. 1. The diagram shows clearly that the tests were carried beyond the point of maximum efficiency of the blower.

The view Fig. 2 shows a 15-horse power blower set which is identical with the one tested, except in respect to size. The arrangement here shown, using a single blower of the Sturtevant type, is used for all sizes from 7 to 55-horse power. From 55 to 300-horse power, where the double geared arrangement of turbine is used, the Sirocco type of blower is employed in blower sets, as this type has a smaller circumference for a given pressure and therefore permits placing two blowers on a common bedplate, staggered in ground plan to clear each other. Such a set is shown in Fig. 3, a set of 150-horse power, having a capacity of 23,000 cubic feet of free air per minute at a pressure of 21 inches water. Fig. 4 shows the impeller wheel of the two types of blower.

The test arrangement for a smaller Sirocco set is shown in Fig. 5. This differs from the arrangement of the test described in this paper only in the different shape of air discharge box used.

Steam turbine blower sets such as are shown in the views Figs. 2 to 5 have been put in service in quite a number of gas plants throughout the country. In the manufacture of coal gas, usually two are installed in a plant, running alternately, for 5 or 6 minutes at a time. The steam pipe connection is provided with a small by-pass which supplies steam enough to keep the turbine just running; the set is thus never completely shut down, which arrangement minimizes the shock when the throttle is fully opened and the load thrown on.

The Technical School and the University.

[From a paper read by MR. H. M. HOWE at the Baltimore meeting of the Association of American Universities.]

Will technical schools serve the interests of the community better if they are parts of great universities, or if they are isolated institutions? Is association or isolation more to the public good?

Let us assume that the university in question deserves its name, having first, a college or academic department of pure science, and second, other important departments, such as schools of law and medicine.

First, let us consider the interaction of the teachers. The practice of the arts taught in technical schools, arts with a scientific basis but still arts, is more nakedly for money making than that of the other professional arts. Medicine heals and raises, law protects the oppressed, dispenses both justice and wisdom from the bench. Even as the servant of finance, it has to do rather with the protection and the transfer of wealth already existing, than with the creation of new wealth, with the fruits of industry rather than with their growth.

But the technical man is always occupied with questions of profit and cost, of making money for his employer, or of building as cheaply as his standard of quality will permit. The merit of every plan is measured in dollars, be it mining and smelting, manufacturing, transportation, or agriculture. The subject must be taught from this standpoint. Our graduates must be sufficient money makers; but it is still more important for the community that they should be liberal citizens.

Surely, it is for the good of the community that the technical teachers should have the softening and broadening influence of contact and work with teachers of the humanities and of pure science, with men to whom the ever present money question is of secondary importance, beauty is more and money less; for so will they in turn influence their students more broadly and humanly; so will their light be whiter and their precepts and example nobler.

Conversely, it is for the good of the public that the teachers of pure science, and more particularly those of the humanities, should, in turn, be broadened by contact with the technical school. Their twist toward scholasticism and away from their students, can be lessened by contact with the technical teacher, especially if, as in the schools of law and medicine, these are in part chosen from the active practitioners. For these technical men are generally of broader and closer experience with men as distinguished from boys, with the mature as distinguished from the adolescent human being. They have striven with men in work in which they have been helped only indirectly by their education, in the great tasks which are before men in a field of human endeavor probably more normal than the scholastic one, that of winning wealth from nature, of first surpassing and then directing their fellows.

Indeed, no argument should be needed to show that every added class of teachers should add to the broadening effect of the environment, and should thus make the attitude of each more just. Each class may, indeed, attack its problems in its own way; but the solution which one finds should aid others.

Here a word as to the interaction of different classes of students. The serious technical student unexpectedly learns from his fellows of the college, of the delights of this or that writer; of the existence of this or that school of philosophy; his interest in things beautiful is awakened; a chat with the student of architecture sets him thinking about the genesis and meaning of logical finished Doric and soaring spiritual Gothic. Each student from another department cries "*Audi alteram partem;* however good and healthy your interests may be, they are only one group out of many." The technical student's horizon is broadened; and truly it needs broadening. According to my observation, narrowness is the chief defect of the isolated technical school.

Like students of the other learned professions, the technical students, are as a class more earnest, more zealous, than their fellows of the college; they are more mature, and they see more clearly than the college student the bearing of their studies upon their life's work. These contagious qualities, zeal and earnestness, should by intercourse with the technical students be caught in some degree by those of the college students who are not thoroughly immune.

But the matter may not be so simple under other conditions, as for instance if, in creating a new technical school, the choice should lie between isolation and association, not with a university, but with some long established college which has as yet no professional schools, and thus is itself isolated. Since the broadening effect of association is here at its weakest, while the zeal chilling influence of the college students is at its strongest, this influence is likely to receive preponderating weight in the minds of those interested in the welfare rather of the projected technical school, than of the general public.

The counsel and learning of the professors of the school of pure science, and of certain professors of the college, should directly benefit the technical school associated with the university by helping to plan and to interpret the researches, both of its teachers and of its advanced students. This widens the field of usefulness of the technical school. Its investigators go farther and deeper, and see more clearly. The better planned research is the better aimed artillery of science; we throw ourselves on the hinge, not on the solid wall. Wise interpretation of results houses the harvest; false interpretation rots it, making poison where food should be.

As with men, so with instruments. Many of the more costly of these are needed imperatively but intermittently. The technical school readily lends hers to the associated school of pure science, and *vice versa*. So, too, with books.

And here we reach the general question of economy. Nobody will deny that increase of scale permits greater economy in administration; even if the locomotive were no faster than the stage coach, its economy would insure its use. Nor are we to fear that our present universities have reached the limit of economical human administration; the history of our great industrial and railroad combinations instructs us here. We do not here ask whether their vast scale has increased their benevolence or beneficence; for our immediate purpose their lesson is

that the present university scale does not approach the limit of the economical and efficient.

To sum up, wisely guided association, while it need neither deprive the technical school of character and individuality, nor injure any of those in interest, should benefit the community, whose welfare here deserves our chief thought, through the broadening interaction of the teachers of pure science and of the college, representing scholarship and culture on one hand, and the technical teachers, with their closer contact with active life, on the other hand; through the interaction of the more earnest technical students and the more broadly studying college students; in a word, through the broader environment which the university offers, with diversity of life and interests, of teachers and students, of museums and galleries. For the adolescent, this environment is to that of the isolated technical school as city life is to village life. Further, the teachers of the school of pure science and of the college should help the technical school in its investigations materially. Finally, the grand scale should effect great economy, not so much in saving salaries and in widening the use of the more expensive instruments, as in fitting work to worker, and best of all, in more fully supplying the eminent with work on their own plane.

The Dry Mixture of Cement.

[A paper read by MR. A. L. GOETZMANN, Chicago, at the Indianapolis meeting of the National Association of Cement Users.]

The subject of my paper is the "Mixture of Concrete." A broad subject and one upon which much has been said and written. There is a strong difference in the treatment not only of the mixture, but subsequent manipulation as between the so called wet or "slop" mixture of ordinary concrete construction and the dry mixture used in the manufacture of cement blocks, a phase of the subject little considered by writers, but of primal importance to those who are engaged in that pursuit.

I have, therefore, taken the liberty of departing from my text to the extent of considering wholly the "dry" mixture and the manufacture of concrete or cement blocks under this method, in the belief that from a discussion of this subject may be evolved a method of procedure for the block manufacturer which may be made of value to the recruit entering the ranks who is now practically without literature and left almost wholly to his own devices.

In this paper I have endeavored to outline methods for cement testing, mixing and general block manufacture which shall, I hope, be of advantage to the small manufacturer, to the man who has not the facilities for elaborate testing, whose business will not permit the employing of expert cement men, but whose failures may militate against our product to the same extent as if he operated in some of our larger cities and on a large scale.

In this effort I have asked for and received the opinions of some of the foremost block and machinery manufacturers of the country as to a few of the more important points connected with block making. I shall advance my own original ideas upon points when block men are at variance, and, as far as possible, hope to bring out sufficient discussion along these lines that the ultimate results may be to the benefit of the average block manufacturer.

The first important consideration in the making of a block is the securing of a cement which answers the purpose of such construction. Needless to say, no natural cement will answer the purpose, Authorities condemn puzzolan cement, so that the matter simmers down to that of Portland cement alone as being satisfactory. In the selection of a Portland cement for block manufacture the question of price should not be considered. That Portland cement, which by testing gives the best results, should be purchased, regardless (at least within due limits) of price. By this I do not mean an imported cement. We are making to-day cements in this country which are fully as good the best imported.

Mr. F. W. Hagloch, C.E., gives in his treatise on the manufacture of artificial stone and concrete some admirably simple rules for cement testing and I do not feel that the subject can be better handled than by quoting him.

"It is the object of this article to give several plain and simple methods of testing cement to a sufficient extent to meet the requirements of cement users. Upon the receipt of a consignment of cement, take a pound sample for every tenth barrel and keep separately; divide it into three equal parts, the first for a water test, the second for tensile strength. For the water test place the sample in a cup or saucer, add water thereto drop by drop. Should the cement absorb the water freely it is a positive sign that it is a Portland cement. Should the cement absorb the water only to a small extent and is dark in color, it is a very low grade Portland cement, but if light in color it is a puzzolan cement made from furnace slag and entirely unfit for artificial stone purposes.

"Dark cement that absorbs water readily is usually a good cement, so far as strength is concerned, but having been burned at low temperature, it is only fireproof to that degree of heat at which it was burned in its process of manufacture. For the second or tensile strength test, take second example of cement, add sand and aggregates of same proportion as you intend in making stone, mix, mold and tamp and season according to instructions for the kind of work you wish to construct. Tensile strength can be best determined with a block 1½ inches square and 6 or 8 inches long. When block is one month old place about 2 inches of one end firmly in a vice and break by applying weights to the free or extended end at a distance of 4 to 6 inches from the vice. A block 1½ inches square made of one part cement and three of sand should carry 400 pounds when seven weeks old. This same block may be used to determine crushing strength, but as crushing strength is usually determined at an earlier date we give the following: Take third and last sample, prepare same as second, and at the end of 20 days crush with sledge, at the same time crushing a similar sized block of hard limestone in the same way and compare the strength of each in this way. The cement must be firmer than the limestone. I am aware that the average engineer ridicules this method, as it is impossible to form a table giving pound weights required in crushing same; but remember that this same engineer would test your cement with other sand or without any sand whatever and pronounce the cement as strictly first-class without the faintest idea of the nature of the sand and aggregates your situation may prove convenient or compel you to use it.

"In defence of these rude but practical methods of testing cement, I wish to state that I have tested cement with modern testing appliances and I have learned that laboratory tests are splendid for advertising, but for real work nothing but practical tests can be relied upon, and practical builders having had experience with cement construction approve the methods explained in this article.

"The test of the greatest practical value is the determining of the rate of setting. This is best done by measuring the time from the moment water is added until the cement paste ceases to be fluid and plastic, which is called the 'initial set,' and when it has aquired a certain degree of hardening is called the hard set.

"All work occasionally requiring retempering of cement must know the time required of the cement used for the initial set or hardening, as retempered cement is almost worthless after once hardened except when used as aggregates.

"Tests for time of setting should be made with sand and aggregates mixed with cement in the proportion intended to be used; time tests with pure cement show different results. Always remember that the setting of the cement is a change from a plastic condition to a solid state."

Sand.—Opinions vary considerably as to sand, running from very fine to very coarse, but all agree on the one point that it should be sharp and clean. It is my own individual opinion that question of size of the sand makes comparatively little difference, so long as it is clean sharp and enough cement be used to properly fill the voids. I have seen blocks which tested good strength by crushing, which are made of a mixture of crushed granite which was passed through a screen of forty to the inch, and also an equally good block made from the very coarsest of torpedo sand.

The main consideration, as I have stated, should be that the sand be free from clay, iron rust, vegetable matter or other impurities and as nearly as possible pure silica. The best sands are those which have been washed to remove these impurities. Care should be exercised in bank sand that there be no nodules, iron rust pockets or rotten stone in the bank. It is recommended oftentimes that two or three different sizes of sand are an advantage, and I quite agree with this, provided the different sizes are screened and the mixture be made of known proportions.

Aggregates.—There seems to be a uniform opinion among machine men that larger material than sand is advantageous, and there is no doubt that where there is enough sand and cement used to fully fill the voids that it makes a cheaper block. As to whether it adds to the strength depends entirely upon the material of which it is made. Such aggregates may vary from size to pass a ¼-inch ring to that which will pass a 1½-inch ring.

An important feature often neglected in making blocks with an aggregate is that of cleanliness. All such material should be thoroughly

washed before incorporating into the concrete. A material with dust or clay on it will effectually resist the adhesion of cement.

Hard crushed limestone, gravel, crushed granite. quartz or trap rock are recommended. Soft limestone is bad on account of its being so great an absorbent of the water, and all limestones are placed under the ban by some on account of the danger of disintegrating in fire.

Mixing.—Upon a proper and thorough mixing of the cement and sand or cement sand and aggregates depends the quality of the finished product. The best of cement and pure silica sand, poorly mixed, will produce a poor block. There are a number of first-class power mixers on the market, and machine mixing is always preferred to hand work, as it produces a uniformly thorough mix, as the hand work will not. Where hand work is necessary, spread the aggregates over the body of the mixing board at a uniform depth, spread the sand evenly over this and the cement over the sand and, with shovels or hoes, turn each over and back at least three times dry, smooth the mixture over with a shovel or hoe and see that the mix is of uniform color. Sprinkle and turn again, sprinkling as it is being turned three times, test for streaky appearances again. Turn until streaks entirely disappear.

As to the proportion which should be used, this is entirely dependent upon the sizes of the sand and aggregates and can only be told by testing.

Most block manufacturers recommend a given proportion as 1 to 5, 1 to 4, etc., with no knowledge of sizes of material to be used. This is not a safe proposition. An excess of cement is waste, and failure will result from a deficiency, and neither can be told until one has a knowledge of materials to be used.

A perfect block is that wherein all the voids are filled and every particle of sand and aggregate is covered with cement.

To secure knowledge as to what is necessary to produce this block, thoroughly dry and screen your aggregates into two sizes. Taken a given volume, say 2 cubic feet of the coarser, mix with this all of the finer which it will take without increasing the volume, mix with this all the sand which it will take without increasing the volume. Add water until it rises to the top of mixture, measure and add, by volume, cement of the volume which the water shows. Where torpedo sand (which runs from the size of a pea down and from which fine sand has been washed) may be obtained, a mixture of the coarser aggregates with the torpedo sand saves the necessity of extra screening and gives same results.

A series of experiments demonstrates that a mixture made with torpedo sand and aggregates ranging from ¼ inch to 1½ inches requires proportions of 1, 2½ and 4. Tests with the coarser and finer materials shows 1 of cement, 2 sand, 2 of fine and 4½ of coarser materials, and where a medium sand is the only available material a proportion of 1 to 4 has proven necessary.

Of such a mixture may be made a block every void of which is filled. Sufficient cement is used so that every particle is covered and so that voids between the granules of sand are filled with cement, making a firm bond between such granules and between the aggregates. Your block is dense, offers strong resistance to the passage of moisture, is fireproof and will stand a crushing strain equal to the very best hard limestones.

For a block composed entirely of sand and cement I should recommend a mixture of two sizes of sand, a coarse and a fine, testing the proportions required exactly as with aggregates. Do not, however, let the matter rest with such tests. In practically every block plant the sizes of sand and aggregates used are constant. These tests are to be used as a starter. Make up your blocks of proportions these tests indicate. After thoroughly cured and dried, break them, note their structure, density, etc. A good block in breaking should break across the stone of the aggregate instead of pulling it from its bed. If possible subject your experimental blocks to test at some good testing laboratory and vary your proportions as such tests teach you. In this, as in every other phase of the block making industry, never admit yourself as knowing all about it or as being perfect. The mixtures above given will not give the fine texture of face required in many instances, and facing of finer material is necessary. For this finer material of crushed granite, marble, glass or fine, clean silicious sand or crushed silica may be used, the degree of fineness depending upon the consistency desired. Such mixtures in proportion of 1 to 3 give good strength and are sufficiently dense.

It is sometimes recommended for securing a whiter face and a more nearly waterproof one, that a percentage of lime be used. This is a dangerous practice, since the deterioration in strength by the admixture of lime is very rapid and results in the hands of the average workman are at least problematical.

The amount of water necessary for the "dry" mixture most used depends upon the materials, the test most often applied being to press some of it in the hand. It should stick together and leave only a small amount of moisture in the palm. The mixture should be just wet enough to cling together after tamping and not enough to stick to the face of the mold. A short experience teaches one so that the appearance of the mixture will tell when sufficiently wet.

Curing.—The curing of a block is to my mind one of the most important processes in the block mannfacture. We may take a block made of the best Portland cement, clean sharp sand, and a satisfactory aggregate, well mixed and thoroughly tamped and spoil it by not properly curing.

The primal requisite in proper curing is water, and plenty of it. The sprinkling of a block two or three times a day is not sufficient. In my opinion, the cement block of a few years hence will be cured entirely under water. The best value of cement is only secured by the admixture of water in quantities as the cement needs it. A block should cure uniformly throughout. The inside is wet continually, with the outside wet but periodically. With the 14 hours of night intervening between sprinkling it is reasonable to suppose that the crystallization will not take place uniformly, internal stresses will set up and the best strength of the block is lost. Cover the finished block after the first 24 hours with hay, straw, burlap, sand or any material which will hold moisture. Thoroughly soak the enveloping material with water and keep it so for at least 6 days.

If this method is not feasible, put on a spray which will run continuously. Let them have all the water they will take up and let them have it when they want it. Cure 6 to 8 days and dry at least 10 before placing in the wall. Do the curing out of the sun and wind.

A series of questions of general interest propounded to twenty cement block and machinery manufacturers brought forth the following replies:

What are your preferences for block manufacture? Eight expressed preference for sand and cement; 6 for sand, crushed stone and cement; 6 for sand, gravel and cement.

What size sand? Coarse, 8; fine, 12.

Do you recommend crushed limestone for blocks? Yes, 5; no, 12; yes, if hard, 3; nine of objectors did so on account of fireproofing considerations.

When sand and cement alone are used, what proportions? Five to one, 3; four to one, 12; three to one, 5.

When larger material, what proportions? One to two, 3, one,two, four, 7; one, two, five, 7; one, three, six, 1; one, two, three, 2.

What length of time do you recommend for curing blocks? Varied from 6 days to 2 weeks. Majority about 7 days.

Have you ever used finely crushed marble, granite or quartz for block manufacture? Yes, 6; no, 8; no answer, 6.

If crushing tests have been made, state results. No answer, 9; no tests, 6; a little less than fine sand, 2; good, 3.

What is your opinion of block so made? No answer, 9; good if properly made, 6; sacrifices strength to beauty, 1; poor, 4.

Summing up these expressions the preponderance of opinion is as follows:

Sand and cement mixture for manufacture. A fine sand preferred to the coarse, proportion of 1 part cement to 4 of sand, opposed to crushed limestone as aggregate. Where aggregates are used, proportions of 1 to 2 to 4 and 1 to 3 to 5 equally favored. Blocks to be cured by sprinkling at least 7 days. Generally opposed to use of fine crushed material for blocks—but experience limited.

The cement block industry has reached that point in its development wherein a meeting such as this and the formation of an Association such as this promises to be is essential.

The business is on its feet, the plant is well started, product selling. It is time to stop and ask ourselves a few questions. Are we doing the best we can? Are we turning out the block we are telling our customers we are? Are we doing all we should for the confidence the building public are placing in us? In other words, don't we need a little more education? Would it not be a good plan for me and my competitors to get together and work up a plan of advertising to acquaint the public, the architect and the engineer with the cement block instead of each endeavoring to convince him that his individual block is the best and only one.

Is not the time here, gentlemen, when we should recognize the common ground upon which we stand? A time which calls for us to get together for the interests of all—education, insurance rates, publicity, laws, etc., etc.

Other interests recognizing the handwriting on the wall are assailing

us. I read but a few days since an article in a magazine devoted to hollow tile and named "Fireproofing," wherein was shown a cement block failure in a little town in Oklahoma. I have endeavored to substantiate the story, but without success. The principle of the illustration, however, is there. The blocks may have been poor; they may have been made of a proportion allowing so little cement that they would absorb their own weight in water. The article was given great prominence, and, from the standpoint of the hollow tile man, deservedly so. The point of the illustration is that the one who most strongly recognizes the competition and is most affected is presenting a solid front against the concrete block.

Our duty is to educate the block maker wherever he operates and whatever block he manufactures, so that failures shall not occur. Educate the public to the value of the cement block. Place our product on a plane to meet the approval of the architects and builders, and give publicity to our fire and other tests.

Devise such ordinances for our cities and towns as will compel the making of a good block and behind which the architect may stand and such as will show the advantages over other products.

A cement block 12 inches thick is stronger than an 18-inch rubble stone wall, yet in most of our cities we stand on the old ordinances and put in our blocks on that basis.

A well made cement block with 30 per cent. voids is stronger than a rubble stone wall of the same thickness, yet the alderman presents an ordinance calling for not exceeding 15 per cent. voids, and we let him do it. Why? Because we have not gotten together, secured expert tests and forced him to take a proper position.

The old illustration of the man's sons and his bundle of rods was never better illustrated than in this new industry.

Let the slogan of the National Association of Cement Users be education for self, education for the public, a perfect block.

The Successful Joint Utilization of Several Small Water Powers.

By W. B. Jackson.

At the present time it is probably not passing beyond the limits of truth to state that the electric current is the best important known transmitting, distributing and translating medium for power and light.

This high position in the arts has been attained only after tremendous struggles in solving the many problems required to make the electric current a suitable and reliable element for commercial use, and many of the most difficult problems yet remain to be solved.

I do not propose to solve these problems in this paper, but wish to present some interesting aspects of electrical construction and operation.

There are certain features in the transmission and utilization of electricity for the production of light and power which have become recognized as of paramount importance in successful commercial installations.

1. Absolute reliability of service.
2. Uniformly good service.
3. Economy of operation, including fixed charges.

A few years ago instantaneous or temporary cessations of the lighting and power service were taken more or less as a matter of course; to-day such irregularities are taken as grave offenses.

Although it has not been long since the variations of pressure from the normal in distribution circuits might have been measured in fives, and even tens of per cent., without a thought; at present service furnished wherein this pressure variation exceeds 2 or 3 per cent. is subject to rightful criticism.

The necessity for the greatest possible economy in operation is more and more marked as the common use of electric current becomes more general, and greater competition enters into its production.

In planning and operating any electric light and power plant these features must be given the best consideration. It may usually be said that when the question of reliability has been solved good service follows as a matter of careful study of the conditions and making the necessary adjustments. These elements bear little or no direct relation to the matter of economical operation.

At the present time a marked change is taking place with respect to the sources of power which are being utilized for transformation into the electric current.

Whereas, in times past, cities of from 20,000 to 30,000 inhabitants almost invariably received all the service needed from a single steam plant centrally located in the city; at the present time not a few of the cities of from 15,000 to 30,000 inhabitants are receiving their power and light from two or more electric plants, one or more of these being hydro-electric plants, capable of furnishing all of the electric service required during certain periods of the year and only a portion of it during the remaining time. This is even true of some of the smaller cities.

I have in mind a city of about 17,000 inhabitants, which has no less than three separate hydro-electric plants, two of these being provided with steam auxiliaries. This is the system of the Janesville Electric Company, of which one of our past presidents, Mr. P H. Korst, is the manager, and in the details of which he takes an intimate interest.

This plant, like numerous others in our Western cities, started many years ago, when the town was young. Its growth was continuous with the town until it was operating about 130-horse power of water wheels and had an engine capacity of 350-horse power, located in the center of the city.

About this time it had the opportunity to add to its available power, under favorable conditions, the Fulton hydro-electric plant, at a distance of about 12 miles from the central plant. In this transmission 3-phase alternating current at 60 cycles and 6,000 volts is generated from the power of the Yahara river.

It was not long before further power was required by the company, and it was again enabled to add to its resources another hydro-electric plant. This is its present Monterey plant, located about 3 miles south of the city, upon the Rock river. Here 350-horse power of water wheels and a 350-horse power engine have been changed from driving a cotton mill (their original sphere of action) to driving a 275 kw. alternating current generator, which furnishes 3-phase current at 60-cycles and 2,300 volts pressure.

Thus the electric company had acquired, step by step, a system comprising:

A centrally located hydro-electric plant with steam auxiliary, together with the requisite distributing circuits and translating devices.

A hydro-electric plant transmitting 3-phase, 6,000 volt alternating current, 12 miles to the central plant.

And a second hydro-electric plant with steam auxiliary, transmitting 3-phase, 2,200 volt electric current 3 miles to the central plant.

The distributing system comprises a 3-wire, 125-volt direct current service furnishing the lighting and power for the central section of the city; a 500-volt street railway circuit for operating the street railway of the city; 3-phase alternating current distributing circuits for furnishing light and power to the outlying districts of the city, and alternating current series arc lighting circuits.

As the central station had outgrown its quarters, and conditions made it undesirable to remain in its old location, it was decided to build a new plant at a point where a much better hydro-electric development could be accomplished, but still affording a centrally located plant for general distribution throughout the city.

The question then confronted the company of determining the best arrangement for the new plant so as to bring together in one united whole the several plants under their control, in order that they might give the most efficient and most satisfactory results in all of the several classes of service to be supplied by their system.

All of the apparatus in the old station was in excellent condition, but it was in small units. Nevertheless, it was decided to utilize practically all of it in the new plant, adding thereto only what was required to take care of the increasing load.

There are not infrequent cases when old apparatus is thrown aside in the reorganization of electric plants to be replaced by more modern and possibly slightly more efficient apparatus, when the actual added net returns from such a change are far less than the added fixed charges, and which, had the old apparatus been suitably continued in service, would have given thoroughly reliable and satisfactory results for many years to come at a positive net saving to the company.

Some of the details of the Janesville system should be of considerable interest to those concerned with the generation and utilization of electric current.

There are installed in the new central referred to 780-horse power of water wheels driving a single shaft extending through the building. This shaft is appropriately sub-divided to permit operating portions of the plant while the others are at rest or undergoing repairs.

Belted to the shaft upon one side are the driving elements, comprising a 350-horse power Corliss engine and two synchronous motors, one for 6,000 volts, the other for 2,200 volts. All of the driven elements, comprising two 125-volt and three 250-volt 75 kw. direct current dynamos and one 110 kw. 500-volt dynamo, can be belted to the shaft from the other side.

Thus suitable space is obtained for all of the driving and driven

machinery and at the same time the belt drive of each unit can be arranged to possess the advantages of having the lower belt upon the pulling side.

Although the usual work of the synchronous motors is to receive power from the other plants and assist the water wheels in driving the main shaft of the central plant, yet when desirable they are driven and used to supply the alternating current required for that portion of the lighting and power system.

By the use of transformers located between the 6,000-volt section and the 2,200 volt section of the switchboards, the 6,000 volt apparatus may be operated in connection with the 2,200-volt apparatus with practically the same facility as though everything was at one pressure.

The arangement of the switchboard is simple, but affords the possibility of operating any one of the plants singly or in any combination with the other plants that the stage of the water may make desirable.

By the arrangement noted a thoroughly practicable and efficient combination is obtained whereby all of the power for supplying the entire service of the electric system may be drawn from any one of the 3 plants, and two of the plants are equipped so that the power may be furnished either by water or steam, as conditions warrant. An efficient combination of the several plants is thus accomplished and the company is remarkably well fortified against possible interruptions of service. Only a very unusual coincidence can simultaneously disable all the sources of supply.

The ability of the alternating current machine to operate either as generator or synchronous motor, without any changes in its connection or switching devices, becomes of great value in systems like that of the Janesville Electric Company, from the point of view of utility, as already referred to, and almost from affording the effect of an equivalent amount of reserve apparatus, thus economizing in space and dispensing with extra driving gear and machinery.

There are not a few plants in operation to-day which might take advantage of this characteristic of alternating current machines to their benefit, but which have not done so. It is not necessary that the conditions of the system should be identical with those of the Janesville Electric Company to make this possible.

In canvassing the necessities of the new central plant it was seen that reserve capacity for the street railway service was highly desirable. This did not appear to be of sufficient moment to warrant the purchase and installation of apparatus which would have to lie idle during almost the entire time. It was therefore decided to add to the one 250-volt direct current dynamo which the company had in use two more like machines, so that any one or more of these could operate upon the 3-wire lighting and power circuits either in connection with two 125-volt direct current generators or in connection with a balancing set or so that any two of the machines could be connected in series with each other and thus be used to furnish 500-volt current for the railway. This afforded reserve capacity for the railway while providing necessary machinery for the lighting service.

These two machines were arranged to accomplish this result by being furnished with double-throw switches which, when thrown up, put the dynamos individually upon the lighting circuits, and, when thrown down, put the dynamos in series with each other upon the street railway circuits.

At present these dynamos are operated with very little compounding, and it is necessary to adjust their fields to keep the load properly divided when they are running in connection with the two compound wound 125-volt dynamos on the 3-wire system.

Mr. Korst proposes to have the connections of the series windings which are now on the machines rearranged so that one-half of the turns will be associated with each terminal of the dynamo. This will make it possible for these dynamos to be operated on the 3-wire system with the 125-volt dynamos and compounded to a corresponding degree.

I might add, that in building the new plant it was deemed advisable to construct the penstocks, forebay and retaining walls entirely out of concrete, thus saving the unending repair and depreciation account so prominent in all timber construction used for such purposes.

Further, it was found that concrete blocks could be obtained under satisfactory conditions for the power house, and this is probably the first electric power house in the State built of these blocks. Thus, in the construction of the buildings, foundations and penstocks, everything between the roof sheathing and the lowest point in the water wheel discharge pits is either of steel, iron or concrete, except the windows and doors and the framing of the wheel house, which latter is covered with corrugated iron.

By bringing these three water powers together into a harmonious system the Janesville Electric Company furnishes all of the electric light and electric power for the city of Janesville and vicinity as well as some electric light for the city of Edgerton, about 11 miles north of Janesville, almost entirely from water power. This nearly eliminates the use of coal in the operation of their plants.

The company maintains 850-horse power of steam auxiliaries for use in case of emergencies and at times of very low water, but experience shows that the hours of service for these will be few.

Specialization in Manufacture.

By Mr. Alexander E. Outerbridge, Jr., Philadelphia.

The industrial structure may be compared to that of a tree. The organization of the industry corresponds to the roots, the common basis and development to the main stem and the special lines of manufacture which are from time to time added as the business grows correspond to the branches of the tree. Formerly it was the ambition of the manufacturer to add as many new branches as possible to the main stem, so that the plant might cover a larger field, and also because of the supposed advantage that in case of a temporary falling off in demand for products of one kind the establishment might be kept occupied continuously through a balancing demand for another product. Thus the manufacturer went on year by year, adding branch after branch to his business, until the concern, which may have started in a very small way, grew to great dimensions, spreading over many lines of industry. The catalogues of such establishments sometimes cover hundreds of pages and included a vast variety of implements or goods.

This plan undoubtedly possessed certain advantages, but it also had serious drawbacks. In the case, for example, of the manufacture of machine tools, where a great variety of machines, such as lathes, planers, etc., are made of different sizes and shapes to suit the wants of many customers, the result is sometimes the accumulation of an enormous stock of costly patterns and fixtures, which are kept in storage for years, perhaps without duplicate orders therefor, and these are finally destroyed to make room for other similar but newer accumulations. When a single new machine is ordered it is customary to make duplicates of many of the parts. These duplicates are carried in stock for future use, sometimes for years, until, in fact, the design becomes obsolete, and then the patterns, fixtures and duplicate parts, which represent a large original investment of money and a continual expense for interest, storage, insurance, etc., are condemned to the scrap heap. Until this times arrives these patterns, castings, duplicate parts, etc., appear as "assets" on the books of the concern, often at a false value, for the annual allowance made for "depreciation" does not cover the ultimate loss due to obsolete fixtures and machines.

Partly as the result of experiences of this nature specialization in manufacturing has become a prominent feature in recent years, resulting in an astonishing decrease in cost and increase in production. Specialization in manufacture means that the manufacturer selects some article or product for which there is a heavy or a constant demand, and through devoting his entire capital, energy and ability to its development and the betterment of the methods or appliances of its manufacture, so reduces his costs on it as to be in at least partial control of the trade. A few illustrations, taken from actual experience, of the advantage of quantity manufacture and undivided attention will be in point:

1. To show the difference in cost where the same machinery and appliances are used, but the quantity is increased. In making two oil pumps for hammer cylinders, the cost is $20.19 each; the same pumps in lots of 12 cost $6.12 each, a reduction of 69 per cent., due largely to the increased quantity, and this reduction could be substantially increased if the quantity should be further increased.

2. To show the difference in cost where different machinery or improved processes are used. For making 100¾ by 4-inch hexagonal head finished bolts, on a modern turret lathe, by reducing the body of the bolt from a commercial bar of hexagonal steel of a size required for the head, the cost is $15.84. Similar bolts are now made by a machine screw company by welding electrically the head (cut from a bar of a hexagonal steel) to the body of the bolt, made from a piece of cold rolled steel the exact diameter of the bolt, and sold for $5.88, which shows a saving in favor of this process of approximately 63 per cent.

3. Where an entirely new process is used. The instance taken is that of the manufacture of cores for molds, where the specialization developed a new process or made it advantageous to apply it. Certain cores which formerly cost $1.18 each now cost 30 cents. Others which formerly cost 56 cents each now cost 14 cents; others which formerly cost $6 each now cost 90 cents, and so on.

The same principles apply in all lines of manufacture, and it has been found that reduction in cost of production, due to specialization in manufacture, is naturally followed by increased demand, for the simple reason that each successive reduction brings a new class of consumers or purchasers into the market, and a commodity which was regarded as a luxury of the few when the cost was relatively high becomes a necessity of the many when the cost is reduced to a sufficiently low level. When the cost has descended to the point which is necessary to establish this condition the demand for the commodity becomes permanent, subject to occasional temporary fluctuations following variations in the general prosperity of a community or the passing of the fad, if it be one.

There are, of course, dangers of over-production in this modern system of specialization, of which we have had many evidences of late, but it seems to be pretty well recognized that the secret of success in manufacturing lies largely in concentration of effort, in developing the plant to the highest degree, so that a superior product may be turned out at a minimum cost.

This implies a complete modern equipment of machinery and modern methods of management. Formerly old tools were venerated; now they are ruthlessly cast away as soon as superior machines can be obtained.

It may be stated as a general proposition that if a new machine be invented which will, by increasing the output only 10 per cent., reduce the cost an equal amount, it pays to scrap the old machine. In many instances improvements have been made which have reduced the cost of manufacture over 50 per cent., and herein lies also one of the dangers of specialization in manufacture.

An establishment may have its capital tied up in a complete outfit of machinery designed to produce one article at the lowest cost, for which there may be a constant demand at a remunerative price. Then an ingenious inventor may design a new machine, or devise a new method of manufacture, which will perhaps produce better goods at far lower cost, and the utility of the old plant is at once destroyed. Its costly machinery may be of little or no value for any other purpose and so a hitherto profitable industry may be wiped out of existence at a stroke. This is not an imaginary statement, but it can be supported by numerous facts.

A few years ago a new method of treating steel for cutting tools was devised, which enabled the tools to cut steel and iron four or five times as rapidly as could be done with any steel tools made up to that time. Shop rights were sold at large figures, and furnaces and others necessary appliances installed in several establishments for treating cutting tools according to this process. In a very short time new alloys were discovered, of which cutting tools are now made, having the same capacity without this costly treatment, and so the value of the process has been largely effaced.

The standardization of parts, now so general, is at once a cause and a result of specializatiou in manufacture. While some large manufacturers make most of their parts in their own factory, few make all, and a large proportion buy many and some buy practically all. Many makers of parts confine their manufacture to a single one. The more recent the development of a mechanical invention the more this practice seems to be adopted.

Certain fundamental principles characterize American methods of manufacture, such as the employment of special machines to perform specific operations only, whereby the output of a factory is enormously increased, minute and systematized division of labor effected, the costly work of finishing and adjusting minimized, and the highest development of skill, accuracy and dispatch acquired. The high wages paid to skilled labor in this country have acted as a stimulus to the invention and perfecting of labor saving machinery, and the employment of such labor saving machinery operated by high priced, intelligent mechanics has resulted sometimes in a very much larger output and lower cost of product per man employed than anywhere in the world under old conditions.

In all lines of manufacture in the United States the same tendency toward specialization is apparent, and it is a question for serious consideration whether this process may not be carried too far, resulting in the future in a variety of unlooked-for evils. Not the least of these perhaps is the decline of the "all-round skilled mechanic." Young men who enter our shops to-day find employment in tending special machines, and soon become highly trained in their operation, so that they earn large wages, consequent, of course, upon their ability to turn out by the aid of these machines the maximum amount of work with minimum of defects. They are encouraged by their employers to continue at one job and feel little ambition to change to another class of work or to another kind of machine, where their experience avails but little. Thus we have skilled planer hands, who know nothing about the operation of lathes, milling machines or other mechanical appliances in the same shops.

The Baldwin Locomotive Works, the largest of the kind in the world, and the most highly developed in specialization of manufacture, has already experienced the difficulty of finding young men competent to take the place of older hands, and has shown wise forethought in establishing a new school of apprentices, with a general superintendent in charge and a staff of supervisors or foremen of apprentices. There are at present three classes of apprentices, numbering in all between 400 and 500 in the works. The apprentices are not kept for an indefinite time in any one department, but are moved from one to another as they advance in experience, so that when they have served their full terms they graduate not as skilled "planer hands" or "lathe operators" merely, but as skilled mechanics. Furthermore, this system develops a feeling of proper ambition in the young man and of attachment to his *alma mater*. This is, in effect, an industrial college for the poor boy, worthy of emulation by other manufacturing establishments; the mutual benefit to employer and employee will be felt in the years to come and will continue to increase in value to all concerned.

The tendency toward specialization is not confined to manufactures. In the foregoing the attempt has been made to tell of and to illustrate its influence and effects in this line. The tendency seems to extend to engineering, medicine and the other professions, indeed to pervade every field of human endeavor. It is an evolution amounting to revolution of methods of doing the world's work.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

In our mention of the annual meeting of the Galveston (Tex.) Gas Company's shareholders it was stated that Mr. Henry J. Runner was chosen a Director. The name should have been Henry I. Runge, and it should have been stated that the name of the Secretary and Treasurer is A. J. Miller, instead of A. J. Sealy. Of course, every gas man knows that the name of the Company's Superintendent is John Gimper, although our types made it read John H. Gimper. The latter is doing quite well; and, better luck on all accounts, the Company and "J. G." are doing a good share of the business that is being done in the city of shifting sands.

The corporate title of the Fox River Light, Heat and Power Company has been changed to that of the Western United Gas and Electric Company. The headquarters of the Company are still in Aurora, Ills.

The proprietors of Messrs. George M. Clark & Company announce that their representative on the Pacific Coast, succeeding the late Mr. Axel Gutsch, is Mr. B. S. Pedersen. His headquarters are 410 Mission street, San Francisco.

At the annual meeting of the St. Paul (Minn.) Gas Light Company the officers chosen were: Directors, Crawford Livingston, Emerson McMillin, Maurice Auerbach, Kenneth Clark, E. A. Young, G. H. Prince and Paul Doty; President, Emerson McMillin; Vice-President, Kenneth Clark; Second Vice-President, Paul Doty; Secretary and Treasurer, J. P. Crowley.

The H. Mueller Mfg. Company, of Decatur, Ills., informs us that it has opened an eastern division office and warehouse, with headquarters and warehouse, 254 to 258 Canal street, corner Elm street, New York. Hereafter, all orders from the territory north of the south Virginia State line, and east of the Pennsylvania State line, will be shipped from the eastern division warehouse, and all accounts for goods shipped to the named territory will be payable thereto.

After months of what well might be called "haggling" over the premises, the Otto Gas Engine Company has determined to locate its new shops in Wilmington, Del.

The proprietors of the Central Foundry Company, of New York, inform us that the United States Government has adopted and installed the Company's "Universal Pipe" for service on Ellis Island, New York Harbor, and has also specified it for other places. The Company's current "booklet" describes the installation on Ellis Island, and the method adopted by the Company in placing its specialty under the Black river, at Lorain, O.

A correspondent in Hartford, Conn., writing under date of the 4th inst., says: "Among the measures introduced in the General Assembly last Tuesday was an act establishing a State Board of Gas and Electric Light Commissioners to consist of 3 members, 1 to be appointed for 2 years, 4 years and 6 years, respectively, none of whom shall be employed by a gas or electric light company, nor own any stock in the same. The salary of the chairman to be $2,500 per annum, and each

of the other commissioners $2,000 per annnm, the expenses to be born, by the several gas and electric light companies in the State. The Board, upon tne complaint of the mayor of any city, or the selectmen, or 25 citizens of any town, as to the quality or price of gas or electricity, may give a public hearing, and after such hearing may order, if they deem just and proper, change in the price of gas or electricity, improvement in the qualitity or distribution of the same. If any company fails to comply with the order of the Board, complaint may be made to the Attorney General, who shall bring an action in the superior court for the enforcement of the orders of the Board. The bill was introduced by Representative Hough of Stamford, and was referred to the committee on cities and boroughs."

A NEW application has been made by certain capitalists for the right to establish a gas plant at Ludington, Mich. The articles of incorporation which have been filed with the County Clerk declare that the name of the ocncern is the Ludington Gas Company, that its capital has been put at $75,000, and that the incorporators are Messrs. Charles A. Coye, B. D. West, C. C. Frazier, O. F. Burkhardt and H. M. Wallace. Mr. Frazier is a resident of Flint, Mich., and the others namcd are prominent residents of Grand Rapids, Mich. From this statement it is not to be taken that Mr. Frazier is without solidity in Flint, for he is engaged in business there as the President of the Princess Manufacturing Company.

AT the annual meeting of the shareholders in the New York and Cleveland Gas Coal Company, held in Pittsburg, Pa., last Wednesday, no change was made in the executive management.

MR. SAMUEL W. WRAY, Secretary of the Connellsville Gas Coal Company, informs us that the annual meeting will be held in the Bullitt Building, Philadelphia, the 27th inst.

THE Louisville (Ky.) *Herald* is our authority for the statement that the contract for the construction of the new plants for the Sedalia (Mo.) Water, Gas and Electric Company, has been awarded to Messrs. Joseph McWilliams & Co., of Louisville. It is further said that the contract involves an expenditure of something less than $145,000.

"THE Junker Calorimeter in Practice" is the title of a well-written, scholarly description of the named apparatus and of approved methods of using the same. It was prepared for the January issue of the "Stevens Indicator" by Mr. Carl F. Dietz.

A CORRESPONDENT in Kansas City, Mo., incloses the following under date of the 4th inst.: "It is asserted that enough natural gas is wasted every month in the gas fields of Southern Kansas to heat and light every town of any importance within a radins of 100 miles. Thousands of wells are giving up this precious fuel and millions of cubic feet of it are never turned to account. On every side one sees gas burning in stores where it is not needed, and the lights going at full blast because it is cheaper to let them burn than to turn them off. To one who visits any of the gas towns southwest of Kansas City for the first time the extravagant use of natural gas appears almost criminal. The writer visited one natural gas town where the whistles in the shops and factories are actually blown by gas instead of steam. How much gas is wasted in this manner every day no one knows or seems to care, but whenever it is time for the men to go to work or to quit at night, or whenever there is a fire or a public celebration of any character in the town, the whistles scream and screech, while natural gas sufficient to light a small town for 24 hours escapes and is wafted away across the prairies. Nor did the town authorities become alarmed when one day an unusually large whistle, with a blood-curling screech that ran through an entire octave from the low to the high notes and back again, got stuck and defied all attempts to shut it off. Yet gas poured out of the valve with a roar for 15 minutes—gas enough to cook all the breakfasts served in a Kansas City hotel this morning. Men who travel in the gas belt regularly say great rivalry exists there among hotel keepers as to who can keep the most gas grates going. A gas fire looks cheerful and inviting on a chilly day, and often gas grates or stoves help to make a hostelry look prosperous. A story is told about one hotel keeper who wanted to get ahead of his competitors. He was enterprising and called in a plumber, whom he directed to put a pipe down each of the halls of the hotel. Then he attached open gas grates to the pipe every 20 feet, so that a guest walking down the corridor did not lose sight of an open gas fire from the moment he left his room until he reached the stairway. He let these fires burn night and day. It was cheaper to let them go than to hire a man to go around and turn them off. In some places in Southern Kansas the manufacturer gets natural gas for 3 cents per 1,000 cubic feet. Schools and public buildings are heated and lighted free of charge. In Chanute and many other towns a visitor notes that lights are kept burning all day long when they are apparently not needed. It is said that it is cheaper to keep the lights going than to hasten the destruction of the mantles used in connection with all these lights by turning them out and lighting them again."

MR. ALFRED A. HOWLETT, a prominent banker of Syracuse, N. Y., and for many years prominently identified with the business affairs of the old Syracuse (N. Y) Gas Light Company, died at his home in Syracuse the night of the 1st inst. Deceased was in his 85th year, having been born in Onondaga, N. Y., February 27, 1821.

THE Public Service Corporation has leased the properties and rights of the Gas and Electric Company of Bergen county, N. J., which matters were among the main assets of the "late" firm of Henry Marquand & Co. As we understand it, the lease is to run for 499 years, the shareholders being guaranteed 2 per cent. dividend for the year from the time of taking over, the rate to be increased 1 per cent. per annum until the maximum of 5 per cent. per annum has been reached. In the long run the Public Service Corporation will have much the better of the deal.

MESSRS. ROBERT O. EATON and Herbert F. Potter, of North Haven, Conn , and Robert J. Woodruff, of Orange, have applied to the Connecticut Legislature for a charter to operate the North Haven Gas and Power Company, with the right to distribute and sell gas and electricity in North Haven and Durham. The concern is capitalized in $75,000.

THE Homer and Cortland (N. Y.) Gas Company and the Cortland Water Company are now, or shortly will be, housed in commodious office quarters in the east section of the Goddard block. The change will be appreciated by the patrons of both concerns.

THE Laramie (Wyo.) Electric, Gas Light and Fuel Company at its annual meeting elected the following officers: Directors, E. D. Hickey, A. C, Jones, C. D. Spalding, R. H. Homer and J. T. Holliday; President, R. H. Homer; Vice-President, J. T. Holliday; Secretary and Manager, John S. Symons; Treasurer, Eli Crumrine.

AT the annual meeting of the shareholders in the Marshall (Mich.) Gas Light Company the following officers were elected: President, Burdette Browne; Vice-President, H. W. Douglas; Secretary, John E. Moore; Treasurer, Charles E. Gorham.

WITH much regret we are obliged to report the death of Mr. George W. Farnham, who for many years was identified with the very best interests of the Lowell (Mass.) Gas Light Company as its Superintendent. His demise occurred at his home in Lowell, the morning of the 5th inst. He had been on the retired list of the Lowell Company for some years, and in his day and time was an active member of the New England Association of Gas Engineers, in the middle life of which his counsel was often sought.

MR. ALCOM, of Suffield, Conn., has offered the following bill in the lower branch of the State Legislature, which has for its object the following: "No corporation engaged in the business of furnishing gas, water or electricity to customers in this State shall make any charge against any customer, nor shall such customer be obliged to pay except for the amount of gas, water or electricity actually used by such customer, and no such corporation shall make, nor shall any customer be compelled to pay any so-called service charge against any customer because such customer fails to use a specified quantity of such gas, water or electricity within a time specified by such corporation, nor shall any such corporation refuse to continue to furnish gas, water or electricity to any customer because of the refusal of such customer to pay for gas, water or electricity not actually used, or refusal to pay such so-called service charge."

MR. JAMES F. RYAN, of Mattapan, Mass., has been appointed Second Assistant Inspector of Gas and Meters by Governor Douglas, succeeding Mr. James L. McDonald, of Boston, who resigned to assume the duties of Assistant Executive State Messenger.

WE are advised that negotiations are underway looking to the purchase of the Litchfield (Conn.) Gas Light Company by the owners of the Litchfield Electric Light and Power Company.

MR. CHARLES NEAL BARNEY, as receiver for the properties and franchises of the Nantucket (Mass.) Gas and Electric Company, has petitioned the Legislature for authority to dispose of the named holdings, by sale and transfer.

MR. GECRGE WILHELM has accepted the position of Manager to the new plant arranged for by Messrs. W. T. Morris and associates at Palmyra, N. Y., Mr. Wilhelm was formerly in charge at Penn Yan, N. Y.

THE plant and properties of the Haverstraw (N. Y.) Company were sold at foreclosure some days ago. The nominal purchaser was Mr. Chas. M. Jessup, of New York city, and his bid was $21,000.

The Market for Gas Securities.

The market for city gas shares was very uneven for the week, although the range of prices was higher than those recorded for some time back. The maximum was close to 213, the average was about 210, and the close was made to-day (Friday) at 208½ to 208¾, which is presumably ex-dividend of 2½ per cent., payable March 15th. The legislative gentlemen in charge of the different sorts of investigations proposed respecting the Consolidated Company have not made good as to their first steps yet; in fact, they seem to flounder more than ever. The ground on which they are treading seems rather yielding. To cut it short, the Company seems to have the better of the going.

Brooklyn Union is 210 to 220, and the probability is that it would be a good thing not to go short of it. Peoples, of Chicago, is 108¾ to 108⅞; Baltimore Consolidated is firm at 84½ to 85. Laclede preferred is quoted at 96 to 100, and those qualified to know in the St. Louis realm are inclined to the belief that the common is worth 70, at least. Washington (D.C.) is 322½, bid.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

FEBRUARY 13.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	208½	208¾
Central Union, Bonds, 5's.	3,000,000	1,000	108½	110
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	118	120
Mutual	8,500,000	100	300	320
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co. .. Bonds, 5's	11,000,000	1,000	112	113¼
New York & Richmond Gas Co. (Staten Island)	1,500,000	100	35	..
1st Mtg. Gold Bds. 5 p. ct.	1,000,000	..	..	..
Northern Union, Bonds, 5's.	1,250,000	1,000	104	106
New York and East River.. Bonds 1st 5's	3,500,000	1,000	112	114
" 1st Con. 5's	1,500,000	..	106¼	108½
Standard	5,000,000	100	125	130
Preferred	5,000,000	100	145	155
Bonds, 1st Mortgage, 5's	1,500,000	1,000	116	117
Yonkers	299,650	500	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	210	220
" " Bonds (5's)	15 000,000	1,000	113	115
Bay State	50,000,000	50	—	—
" ncome Bonds	2,000,000	1,000	..	75
Binghamton Gas Works..	450,000	100	28	30
" 1st Mtg. 5's	500,000	1,000	93	96
Boston United Gas Co.— 1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	5	5¾
" " Bonds, 5's	5,250,000	1,000	66	68½
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Cincinnati Gas and Electric Co	29,500,000	100	107¾	108
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	97½	99
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	88¼	89¼
Preferred	3,096,500	100	107½	109
Consumers, Toronto	,000,000	50	200	204
Consolidated, Baltimore..	11,000,000	100	84½	85
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's.	1,000,000	..	..	..
Equitable, 1st 6's.	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N.J.	1,000,000	100	15	17
" Con. Mtg. 5's	880,000	1,000	89½	92
Bonds	75,000	..	..	100
Detroit City Gas Co	4,825,500	50	..	50
" Prior Lien 5's	5,603,000	1,000	99½	100
Detroit Gas Co., 5's	381,000	1,000	75	75¼
" Inc. 5's	16,000	100	98½	100
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	...	101
Essex and Hudson Gas Co.	6,500,000	..	39	40
Fort Wayne	2,000,000	..	..	..
" Bonds	2,000,000	..	55	..
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,225,000	1,000	104½	105
Hartford	750,000	25	190	200
Hudson County Gas Co., of New Jersey	10,500,000	..	104½	105½
" Bonds, 5's	10,500,000	..	107	108
Indianapolis	2,000,000	..	70	75
" Bonds, 6's	2,650,000	..	106½	108
Jackson Gas Co	250,000	50	82	..
" 1st Mtg. 5's	290,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	..	..
Preferred	2,500,000	100	96	100
Bonds	10,000,000	1,000	108½	109
Lafayette Gas Co., Ind.	1,000,000	100	..	60
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	136	140
Madison Gas & Elec. Co. " 1st Mtg. 6's	350,000	1,000	107½	108¼
" 6 per cent. scrip, due 1910	100,000	25	85	87
Montreal, Canada	2,000,000	100	218	218¾
Nashville Gas Lt. Co.	1,000,000	100	110	..
Newark, N. J., Con. Gas Co.	6,000,000	..	56	58
Bonds, 6's	4,600,000	..	105	105¾
New Haven	2,000,000	25	200	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	108¾	108¾
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
2d "	2,500,000	1,000	104	
Rochester Gas & Elec. Co..	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	15,800,000	100	58½	58¾
St. Joseph Gas Co. " 1st Mtg. 5's	731,000	1,000	94	96
St. Paul Gas Light Co	1,500,000	100	45	47
1st Mortgage 6's	650,000	1,000	113	116
Extension, 6's	600,000	1,000	112½	115
General Mortgage, 5's..	2,465,000	1,000	92	93

Advertisers' Index.

GAS ENGINEERS.

A. E. Boardman, New York City 250
Baxter & Young, Detroit, Mich 272
B. E. Chollar, St. Louis, Mo 269
David Leavitt Hough, New York City 272
Davis & Farnum Mfg. Co., Waltham, Mass 272
Economical Gas Apparatus Construct'n Co., Toronto, Ont. 264
Frank D. Moses, Trenton, N. J 261
Fred Bredel Co., Milwaukee, Wis 260
Frederic Egner, Washington, D. C 264
Geo. G. Ramsdell, New York City 217
Geo. R. Rowland, New York City 268
Humphreys & Glasgow, New York City 273
Isbell-Porter Co., Newark, N J 274
J. Alex. Mayers, New York City 275
J. F. W. Jost, Philadelphia, Pa 268
Kerr Murray Mfg. Co., Fort Wayne, Ind 272
The Gas Machinery Co., Cleveland, O 260
The Jeffrey Manufacturing Co., Columbus, O 270
The Western Gas Construction Co., Fort Wayne, Ind... 240
United Gas Improvement Co., Philadelphia, Pa 267

GAS WORKS APPARATUS AND CONSTRUCTION.

A. E. Boardman, New York City 250
Bartlett, Hayward & Co., Baltimore, Md 273
Baxter & Young, Detroit, Mich 272
Connelly Iron Sponge and Governor Co., New York City 269
Continental Iron Works, Brooklyn, N. Y 274
Cruse-Kemper Co., Philadelphia, Pa 269
Davis and Farnum Mfg. Co., Waltham, Mass 272
Deily & Fowler, Philadelphia, Pa 276
Economical Gas Apparatus Construct'n Co., Toronto, Ont. 264
Empire Gas Construction & Improvement Co., N. Y. City 259
Frank D. Moses, Trenton, N. J 261
Fred. Bredel Co., Milwaukee, Wis 260
G. Shepard Page's Sons, New York City 272
Humphreys & Glasgow, New York City 272
Isbell-Porter Company, New York City 274
J. Alex. Mayers, New York City 275
Kerr Murray Mfg. Co., Fort Wayne, Ind 272
Lloyd Construction Co., Detroit, Mich 262
Logan Iron Works, Brooklyn, N. Y 273
Quintard Iron Works, New York City 273
R. D. Wood & Co., Philadelphia, Pa 274
Riter-Conley Mfg. Co., Pittsburg, Pa 275
Stacey Mfg. Co., Cincinnati, O 275
The Connersville Blower Company, Connersville, Ind.. 277
The Gas Machinery Co., Cleveland, O 260
The Jeffrey Manufacturing Co., Columbus, O 270
The Western Gas Construction Co., Fort Wayne, Ind.... 240
United Gas Improvement Co., Philadelphia, Pa 267

PROCESSES.

Bartlett, Hayward & Co., Baltimore, Md 273
B. E. Chollar, St. Louis, Mo 269
Economical Gas Apparatus Construct'n Co, Toronto, Ont. 264
Fred. Bredel Co., Milwaukee, Wis. 260
Humphreys & Glasgow, New York City 273
The Gas Machinery Co., Cleveland, O 260
The Western Gas Construction Co., Fort Wayne, Ind.... 240
United Gas Improvement Co., Philadelphia, Pa. 267

SCRUBBERS AND CONDENSERS.

Continental Iron Works, Brooklyn, N.Y 274
Davis & Farnum Mfg. Co., Waltham, Mass. 272
Economical Gas Apparatus Construct'n Co., Toronto, Ont. 264
Fred. Bredel Co., Milwaukee, Wis 260
Isbell-Porter Co., Newark, N. J 274
Kerr Murray Mfg. Co , Fort Wayne, Ind 272
Logan Iron Works, Brooklyn, N. Y 276
R. D. Wood & Co., Philadelphia, Pa 274
Riter-Conley Mfg. Co., Pittsburg, Pa 275
Stacey Mfg. Co., Cincinnati, O 275
The Gas Machinery Co., Cleveland, O 260
The Western Gas Construction Co., Fort Wayne, Ind.... 240

PRODUCER POWER PLANTS.

Economical Gas Apparatus Construct'n Co., Toronto, Ont. 264
R. D. Wood & Co., Philadelphia, Pa 274

TAR AND CARBONIC ACID EXTRACTOR.

Economical Gas Apparatus Construct'n Co., Toronto, Ont. 264
Fred. Bredel Co., Milwaukee, Wis 260
Isbell-Porter Co.. Newark, N. J 274
Stacey Mfg. Co., Cincinnati, O 275
The Gas Machinery Co., Cleveland, O 260
The Western Gas Construction Co., Fort Wayne, Ind... 240

AMMONIA CONCENTRATORS.

Fred. Bredel Co., Milwaukee, Wis 260
Michigan Ammonia Works, Detroit, Mich 256
The Gas Machinery Co., Cleveland, O 260
The Western Gas Construction Co., Fort Wayne, Ind... 240

GAS METERS.

American Meter Co., New York and Philadelphia 279
Detroit Meter Company, Detroit, Mich 239
D. McDonald & Co., Albany, N.Y 277
Helme & McIlhenny, Philadelphia, Pa 279
John J. Griffin & Co., Philadelphia, Pa 280
Keystone Meter Co., Royersford, Pa 278
Maryland Meter and Mfg. Co., Baltimore, Md 278
Metric Metal Co., Erie, Pa 279
Nathaniel Tufts Meter Co., Boston, Mass 278

PREPAYMENT METERS.

American Meter Co., New York and Philadelphia 279
D. McDonald & Co., Albany, N. Y 277
Helme & McIlhenny, Philadelphia, Pa 279
John J. Griffin & Co., Philadelphia, Pa 280
Keystone Meter Co., Royersford, Pa 278
Nathaniel Tufts Meter Co., Boston, Mass 278

PREPAYMENT METER ATTACHMENTS.

Reeves Mfg. Co., New Haven, Conn 263

GAS AND WATER PIPES.

Centra Foundry Co., New York City 264
Charles Millar & Son Co., Utica, N. Y 264
Davis & Farnum Mfg. Co., Waltham, Mass 272
Donaldson Iron Co., Emaus, Pa 264
Economical Gas Apparatus Construct'n Co., Toronto, Ont. 264
R. D. Wood & Co., Philadelphia, Pa 274
Warren Foundry and Machine Co., New York City 264

GAS COALS.

Berwind-White Coal Mining Co., New York and Phila. 270
Perkin & Co., New York City 270
Westmoreland Coal Co., Philadelphia, Pa 271

SPECIALTIES FOR OIL AND PIPE LINES.

S. R. Dresser, Bradford, Pa 261

GAS MAIN STOPPERS.

Safety Gas Main Stopper Co., N.Y. City 264

MAIN AND SERVICE LAYING.

Sullivan Bros., Flushing, N. Y 235

GAS TAPPING MACHINES.

George Light, Dayton, O 264
H. Mueller Manufacturing Company, Decatur, Ills 262

CANNEL COALS.

Perkins & Co., New York City 270

STOKING MACHINERY.

G. A. Bronder, New York City 269

CONVEYORS.

Adam Weber Sons, New York City 263
C. W. Hunt Company, New York City 260
Economical Gas Apparatus Construct'n Co., Toronto, Ont. 264
Fred. Bredel Co., Milwaukee, Wis. 260
G. A. Bronder, New York City 269
Kerr Murray Mfg. Co., Fort Wayne, Ind 272
The Brown Hoisting Machinery Co., Cleveland, O 271
The Gas Machinery Co., Cleveland, O 260
The Jeffrey Manufacturing Co., Columbus, O 270
The Link-Belt Engineering Co., Philadelphia, Pa 261
The Link-Belt Machinery Co., Chicago, Ills 264
The Western Gas Construction Co., Fort Wayne, Ind... 240

CHARGING BARROWS & COAL WAGONS.
Davis & Farnum Mfg. Co., Waltham, Mass..... 272
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 272
Stacey Mfg. Co., Cincinnati, O..... 275

GAS ENRICHERS.
Standard Oil Co., New York City..... 231
Sun Company, Pittsburg, Pa..... 271
The Sun Oil Co., Pittsburg, Pa..... 271

COKE CRUSHERS.
C. M. Keller, Columbus, Ind..... 271
Fred. Bredel Co., Milwaukee, Wis..... 260
The Jeffrey Manufacturing Co., Columbus, O..... 270

STEAM BLOWER FOR BURNING BREEZE.
De Laval Steam Turbine Co., Trenton, N. J..... 253
The Connersville Blower Company, Connersville, Ind.. 277

ECONOMIZERS.
Green Fuel Economizer Co., Matteawan, N.Y..... 268

GAS GAUGES.
The Bristol Co., Waterbury, Conn..... 268

GAS GOVERNORS.
Connelly Iron Sponge and Governor Co., New York City 269
Fred. Bredel Co , Milwaukee, Wis..... 260
Isbell-Porter Co., Newark, N. J..... 274
R. D. Wood & Co., Philadelphia, Pa..... 274

CEMENTS.
C. L. Gerould, Bloomington, Ind..... 268

RETORTS AND FIREBRICKS.
Adam Weber Sons, New York City..... 238
Baltimore Retort and Firebrick Co , Baltimore, Md..... 268
Brooklyn Firebrick Works, Brooklyn, N. Y..... 268
Harbison-Walker Refractories Co., Pittsburg, Pa..... 257
Henry Maurer & Son, New York City..... 268
James Gardner, Jr., Co., Pittsburg, Pa..... 268
J. H. Gautier & Co., Jersey City, N. J..... 266
Laclede Firebrick Mfg. Co., St. Louis, Mo..... 268
Missouri Firebrick Co., St. Louis, Mo..... 268
Parker-Russell Mining and Mfg. Co., St. Louis, Mo..... 257

INCLINED RETORTS.
Adam Weber Sons (Graham, Morton [England] System) 248
Fred. Bredel Co., Milwaukee, Wis..... 260
Geo. G. Ramsdell, New York City..... 271
Parker-Russell Mining and Mfg. Co., St. Louis, Mo 258

VERTICAL S'S.
Adam Weber Sons (Oscar B. Weber's Construction)..... 268
Connelly Iron Sponge & Gov. Co. (Drake's [Eng.] System) 269
Fred. Bredel Co., Milwaukee, Wis..... 260
Parker-Russell Mining and Mfg. Co., St. Louis, Mo..... 258

VERTICAL RETORTS, CHARGING AND DISCHARGING VERTICALLY.
Adam Weber Sons, New York City..... 268

REGENERATIVE FURNACES.
Adam Weber Sons, New York City..... 268
Bartlett, Hayward & Co., Baltimore, Md..... 276
Fred. Bredel Co., Milwaukee, Wis..... 260
J. H. Gautier & Co., Jersey City, N. J..... 264
Laclede Firebrick Mfg. Co., St. Louis, Mo..... 268
Missouri Firebrick Co., St. Louis, Mo..... 268
Parker-Russell Mining and Mfg. Co., St. Louis, Mo..... 258

SELF-SEALING MOUTHPIECE DOORS.
Continental Iron Works, Brooklyn, N.Y. 274
Davis & Farnum Mfg. Co., Waltham, Mass..... 272
Fred. Bredel Co., Milwaukee, Wis..... 260
Isbell-Porter Co., Newark, N. J..... 274
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 272
Logan Iron Works, Brooklyn, N.Y..... 276
R. D. Wood & Co., Philadelphia, Pa..... 274
Stacey Mfg. Co., Cincinnati, O..... 275
The Gas Machinery Co., Cleveland, O..... 260
The Western Gas Construction Co., Fort Wayne, Ind.. 240

CHIMNEY CONSTRUCTION.
Adam Weber Sons, New York City..... 268

INCANDESCENT GAS LAMPS.
Central Lighting Co., New York City..... 259
D. M. Steward Mfg. Co., Chattanooga, Tenn..... 258
General Gas Light Co., Kalamazoo, Mich..... 259
Geo. G. Ramsdell, New York City..... 217
Welsbach Company, Gloucester, N. J..... 266

BURNERS.
Central Lighting Co., New York City 259
D. M. Steward Mfg. Co., Chattanooga, Tenn..... 258
Wm. M. Crane Co., New York City..... 261

LAVA GAS TIPS.
D. M. Steward Mfg. Co., Chattanooga, Tenn..... 258

STREET LAMPS.
Thos. T. W. Miner, New York City..... 260
Welsbach Street Lighting Co., New York and Phila.... 266

PURIFIERS.
Connelly Iron Sponge and Governor Co., New York City. 269
Davis & Farnum Mfg. Co., Waltham, Mass..... 272
Fred. Bredel Co., Milwaukee, Wis..... 260
Isbell-Porter Co., Newark, N. J..... 274
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 272
R. D. Wood & Co., Philadelphia, Pa..... 274
Stacey Mfg. Co., Cincinnati, O..... 275
The Western Gas Construction Co., Fort Wayne, Ind... 240

PURIFYING MATERIALS.
Connelly Iron Sponge and Governor Co., New York City 269

VALVES.
Continental Iron Works, Brooklyn, N. Y..... 274
Davis & Farnum Mfg. Co., Waltham, Mass..... 272
Economical Gas Apparatus Construct'n Co., Toronto, Ont 261
Isbell-Porter Co., Newark N. J..... 274
Kerr Murray Mfg. Co., Fort Wayne, Ind 272
Ludlow Valve Manufacturing Co., Troy, N.Y..... 261
R. D. Wood & Co., Philadelphia, Pa..... 274
Stacey Mfg. Co., Cincinnati, O..... 275
The P. H. & F. M. Roots Co., Connersville, Ind..... 243
The Western Gas Construction Co., Fort Wayne, Ind... 240

(Continued on page 256.)

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(*Concluded from page 255.*)

PUMPS.

De Laval Steam Turbine Co., Trenton, N. J..... 256

EXHAUSTERS.

Connelly Iron Sponge and Governor Co., New York City 269
Davis & Farnum Mfg. Co., Waltham, Mass..... 272
Isbell-Porter Company, Newark, N. J..... 274
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 272
The Connersville Blower Company, Connersville, Ind... 277
The P. H. & F. M. Roots Co., Connersville, Ind..... 263

PURIFIER SCREENS.

John Cabot, Hoboken, N. J..... 260

GRATE BARS.

F. Ferguson & Son, Hoboken, N. J..... 264

GAS STOVES.

American Meter Co., New York and Philadelphia..... 279
Detroit Stove Works, Detroit and Chicago..... 278
Keystone Meter Co., Royersford, Pa..... 278
Maryland Meter and Manufacturing Co., Baltimore, Md. 278
Nathaniel Tufts Meter Co., Boston, Mass..... 278

HOT WATER HEATERS.

Humphrey Co., Kalamazoo, Mich..... 260

GASHOLDER TANKS.

J. P. Whittier, Brooklyn, N.Y..... 268

GASHOLDERS.

Bartlett, Hayward & Co., Baltimore, Md..... 273
Continental Iron Works, Brooklyn, N.Y..... 274
Cruse-Kemper Co., Philadelphia, Pa..... 269
Davis & Farnum Mfg Co., Waltham, Mass..... 272
Deily & Fowler, Philadelphia, Pa..... 276
Economical Gas Apparatus Construct'n Co., Toronto, Ont. 261
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 272
Logan Iron Works, Brooklyn, N.Y..... 276
R. D. Wood & Co., Philadelphia, Pa..... 274
Riter-Conley Mfg. Co., Pittsburg, Pa..... 276
Stacey Mfg. Co., Cincinnati, O..... 275

STORAGE TANKS.

Davis & Farnum Mfg. Co., Waltham, Mass..... 272
Stacey Mfg. Co., Cincinnati, O..... 276

PAINTS.

American Standard Composition Co., New York City... 256
National Paint Works, New York City..... 272

PATENTS, TRADE-MARKS, COPYRIGHTS.

Royal E. Burnham, Washington, D. C..... 260

STEAM TURBINES.

De Laval Steam Turbine Co, Trenton, N. J..... 256

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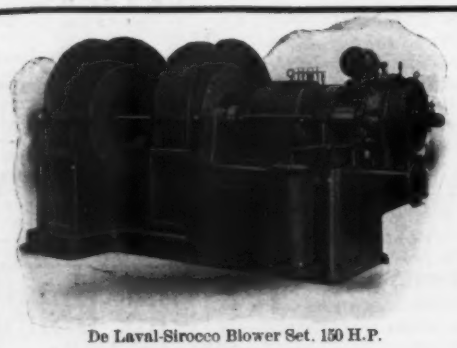

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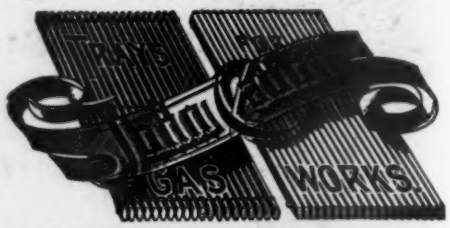

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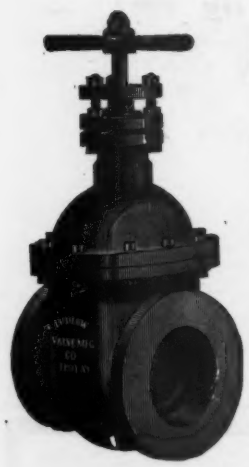

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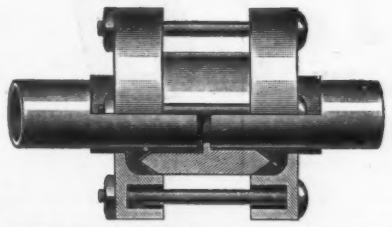
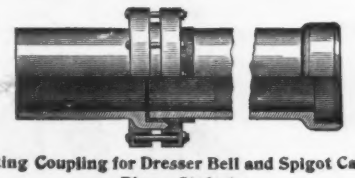
Patentee and Manufacturer of Specialties for Oil and Gas Lines.

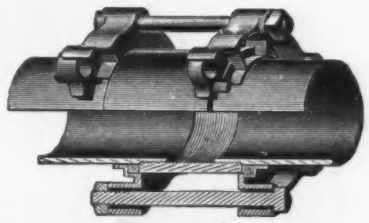


Insulating Coupling for Wrought Iron Pipe. Style 5.

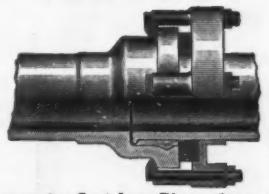


Insulating Coupling for Dresser Bell and Spigot Cast Iron Pipe. Style 6.

Regular Sleeve. Style 2.



Clamp. Style 4.



Clamps for Cast Iron Pipe. Style 4½.

Pipe Couplings, Sleeves, Clamps, Crosses, Tees and Ells.

My Insulating Coupling prevents the destruction of pipe by electrolytic action, in either water or gas lines.

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Telephone, 204-A TRENTON, N. J., Telephone, 204-A

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Estimates Furnished on any kind of Work in Connection with Gas or Water Plants.

SPECIAL ATTENTION GIVEN TO THE REMODELLING AND EXTENDING OF THE PROPERTIES OF WORKS NOT UP-TO-DATE.

CORRESPONDENCE SOLICITED.

LLOYD'S P. & A.

Total daily capacity sold during January, 1905,

40,300,000.

LLOYD CONSTRUCTION CO.,
DETROIT, MICH.

MUELLER GAS MAIN TAPPING MACHINES.

SWIVEL No. 1 MACHINE.

C—1004.

The use of a gas main tapping machine having a stationary feed screw support is sometimes attended with inconvenience because of the support interfering with the use of the handle to the best advantage.

In Mueller Gas Main Tapping Machines the feed screw support or gooseneck is swiveled to the body, and adjustable to any position most advantageous to the movement of the handle. No inconvenience of any character attends their use.

Mueller Gas Main Tapping Machines are made in seven different styles for different classes of work, and make taps from ¾ to 3-inch in any size of pipe. The machine illustrated is Mueller Swivel No. 1, which makes taps from ¾ to 2-inch in pipes from 4 inches to the largest.

Each machine is given a workmark, and is *unconditionally guaranteed.*

We also make a full line of gas cocks and meter connections for gas works' use. Catalogues upon application.

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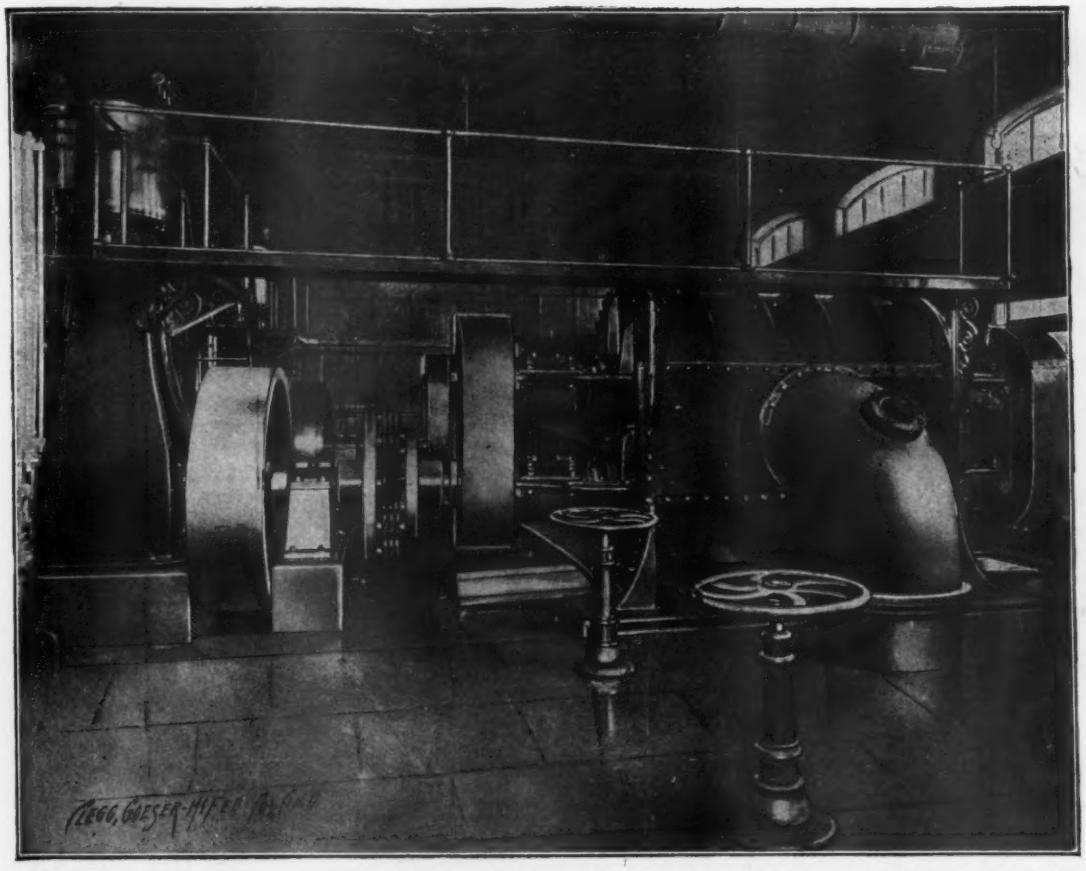
EASTERN WAREHOUSE—Located at 254-258 Canal Street (cor. Elm), New York City, carries a full stock of Mueller goods.

THREE GRAND PRIZES were awarded Mueller Water, Gas and Plumbing goods, respectively, at St. Louis.

H. MUELLER MFG. CO.,

DECATUR, ILLS., U. S. A. NEW YORK, N. Y., U. S. A.

ROOTS' GAS EXHAUSTERS.



GOLD MEDAL AT ST. LOUIS, 1904.

Installation showing our latest improved machines, with flexible rope coupling, for large units.

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HOME OFFICE:
Connersville, Ind.

NEW YORK OFFICE:
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USE YOUR OWN
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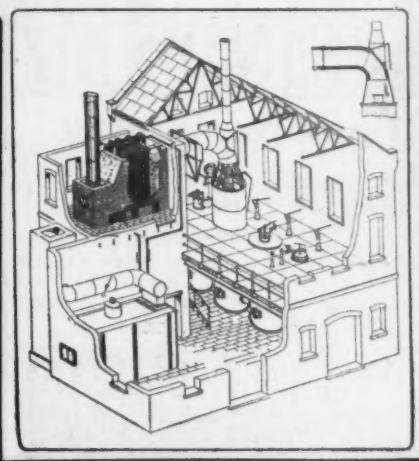
We can send you scores of testimonials from customers, but if you are not yet using our attachments we will send you a sample, free. Try it. If not the you have ever used, we will not expect your trade. :: :: :: :: :: :: BEST
Long warning to consumers, entirely preventing fatal accidents. Other important features.

REEVES MFG. CO., - - - - - New Haven, Conn.



Steam + Fuel

Green's Fuel
Economizer.

This view shows installation in Poughkeepsie Gas Works connected with one six-foot U. G. I. set.

25 per cent. less fuel has been used since its installation in March, 1900.

Our expert's services are always obtainable free of charge. May we send booklet?

THE GREEN FUEL ECONOMIZER CO.,
Sole Manufacturers in the United States. **MATTEAWAN, N. Y.**

GEORGE ORMROD, Mangr. & Treas., Emaus, Pa.
JOHN DONALDSON, Prest., Betz Bldg., Phila., Pa.

EMAUS PIPE FOUNDRY.

DONALDSON IRON COMPANY. EMAUS, PA.

MANUFACTURERS OF

CAST IRON PIPE AND SPECIAL CASTINGS

FOR WATER AND GAS.

Also, FLANGE PIPE, LAMP POSTS, Etc.

GAS TAPPING MACHINES

—FOR—

Drilling and Tapping Pipe under Pressure

WITHOUT ANY ESCAPE OF GAS.

They are Strong and Compact.

Size of Combination Drills and Taps ¾ to 4-inch.

Machines Sent to any Gas Company for Thirty Days' Trial.

Send for Circulars.

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THE ECONOMICAL GAS APPARATUS CONSTRUCTION COMPANY, LIMITED,

Consulting Engineers.

Builders of UP-TO-DATE Machinery and Appliances for Coal and Water Gas Plants. :: :: :: :: ::

PLANS,
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AMERICAN OFFICE:
269 Front St., East, Toronto, Canada.

FREDERIC EGNER,
Gas Engineer,
NORFOLK, VA.,

May be consulted with reference to estimates of cost for new, or appraising actual value of existing works; utility of proposed or patented processes; relative earning power to capitalization, and management.

J. F. W. JOST,
CHEMICAL ENGINEER
—IN—
GAS MANUFACTURE,
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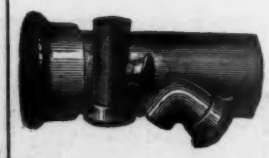
WARREN FOUNDRY AND MACHINE CO.,

Established 1856. Works at Phillipsburgh, N. J.

New York Office, 160 Broadway.



CAST IRON WATER AND GAS PIPE,

FROM THREE TO FORTY-EIGHT INCHES DIAMETER. ALSO, ALL SIZES OF

Flange Pipe for Sugar House and Mine Work. Branches, Bends, Retorts, etc., etc.

UNIVERSAL PIPE HAS
METALLIC JOINTS
THAT DO NOT LEAK.
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CHARLES MILLAR & SON CO., Selling Agents, Utica, N.Y.

Flanged Pipe and Fittings, Hydrants, Gates, Pig Lead, Jute, etc.

UTICA PIPE FOUNDRY CO.

Manufacturers of Lead Pipe, Solder, etc., and Jobbers of Plumbers' and Tinners' Goods.

CAST IRON PIPE and SPECIALS FOR WATER AND GAS.

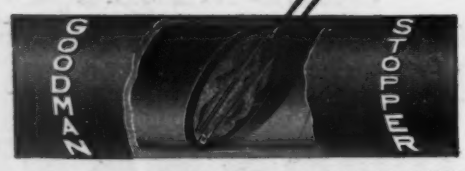
Wholesale Eastern Agents AKRON VITRIFIED SEWER PIPE.

SAFETY GAS MAIN STOPPER COMPANY,

For Shutting Off Gas in Mains

Temporarily during alterations and repairs. : : : :

Any size gas main can be shut off in 30 seconds. : : :



STOPPERS SENT ON TRIAL.

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FINE OPENING

GRATE BARS

FOR GAS WORKS.

STATIONARY, SHAKING, DUMPING.

BARS FOR HAZELTON BOILERS.

LINK-BELT

OPEN TOP CARRIER.

ESPECIALLY ADAPTED FOR HANDLING

Coal, Coke, Ashes, Stone, Ores,

Or any heavy or gritty materials, where strength and durability are essential. Constructed in any length or capacity, and to suit local conditions.

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Link-Belt Engineering Co. Philadelphia
Chicago, U.S.A.

AMERICAN METER CO.,

NEW YORK, ST. LOUIS, PHILADELPHIA, SAN FRANCISCO, CHICAGO,

Photometrical and Experimental Apparatus.

PUBLIC LIGHTING TABLE.

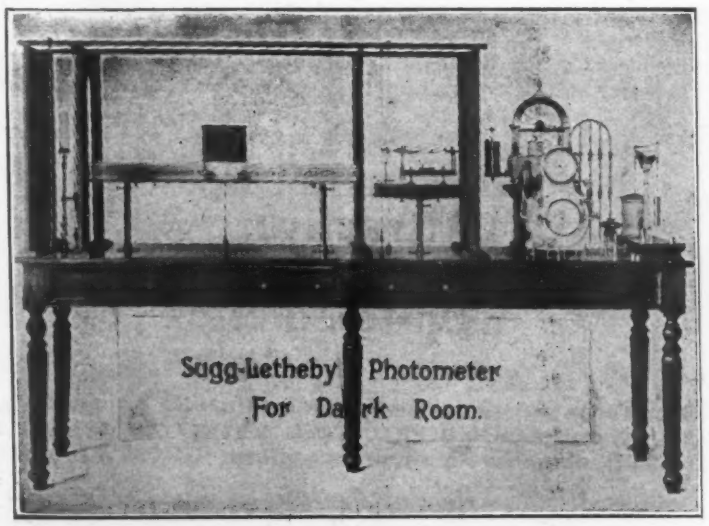
FEBRUARY, 1905.

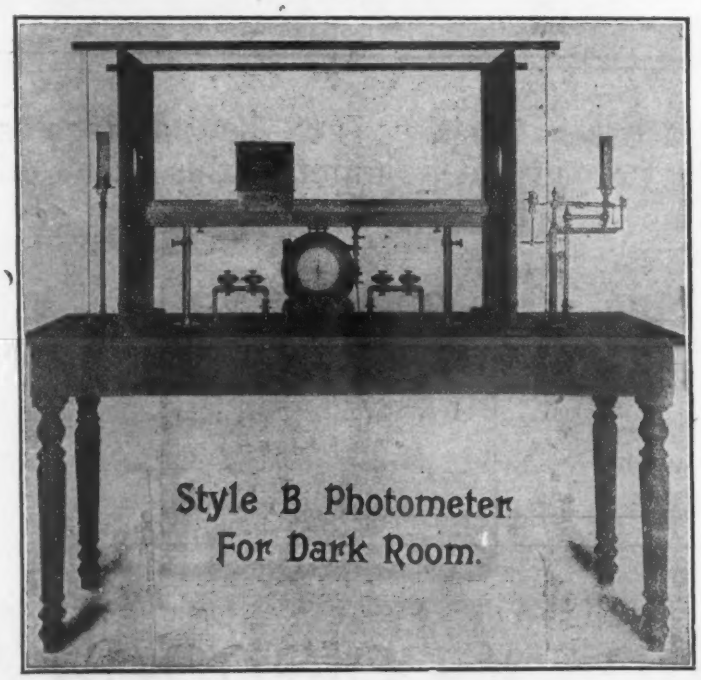
Day of Week.	Date.	Table No. 1. FOLLOWING THE MOON. Light.	Extinguish.
Wed.	1	5.50 PM	6.10 AM
Thu.	2	5.50	6.10
Fri.	3	5.50 NM	6.10
Sat.	4	5.50	6.10
Sun.	5	5.50	6.00
Mon.	6	5.50	6.00
Tue.	7	5.50	6.00
Wed.	8	8.30	6.00
Thu.	9	9.30	6.00
Fri.	10	10.30	6.00
Sat.	11	11.20	6.00
Sun.	12	12.20 AN FQ	5.50
Mon.	13	1.20	5.50
Tue.	14	2.10	5.50
Wed.	15	3.10	5.50
Thu.	16	4.00	5,50
Fri.	17	4.50	5.50
Sat.	18	No L.	No L.
Sun.	19	No L. FM	No L.
Mon.	20	No L.	No L.
Tue.	21	6.10 PM	9.10 PM
Wed.	22	6.10	10.30
Thu.	23	6.10	11.40
Fri.	24	6.10	12.40 AM
Sat.	25	6.10 LQ	1.50
Sun.	26	6.20	2.50
Mon.	27	6.20	3.40
Tue.	28	6.20	4.40

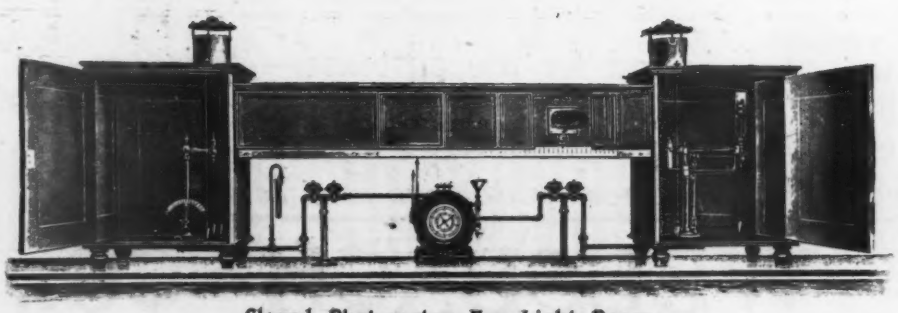
TOTAL HOURS DURING 1905.

By Table No. 1.

	Hrs.Min.
January	240.50
February	192.20
March	207.00
April	175.10
May	161.00
June	139.50
July	149.00
August	161.50
September	173.00
October	205.00
November	211.00
December	229.00
Total, yr.	2245.00







Closed Photometer For Light Room.

CIRCULARS SENT ON REQUEST.

PUBLIC LIGHTING TABLE.

FEBRUARY, 1905.

Day of Week.	Date.	Table No. 2. NEW YORK CITY. All Night Lighting. Light.	Extinguish.
		A.M.	P.M.
Wed.	1	5.05	6.15
Thu.	2	5.05	6.15
Fri.	3	5.05	6.15
Sat.	4	5.05	6.15
Sun.	5	5.10	6.10
Mon.	6	5.10	6.10
Tue.	7	5.10	6.10
Wed.	8	5.10	6.10
Thu.	9	5.10	6.10
Fri.	10	5.10	6.10
Sat.	11	5.10	6.10
Sun.	12	5.20	5.55
Mon.	13	5.20	5.55
Tue.	14	5.20	5.55
Wed.	15	5 20	5.55
Thu.	16	5.20	5.55
Fri.	17	5.20	5 55
Sat.	18	5.20	5 55
Sun.	19	5.30	5.55
Mon.	20	5.30	5.55
Tue.	21	5.30	5.55
Wed.	22	5 30	5.55
Thu.	23	5.30	5.55
Fri.	24	5.30	5.55
Sat.	25	5 30	5.55
Sun.	26	5.30	5.45
Mon.	27	5.30	5.45
Tue.	28	5.30	5.45

TOTAL HOURS DURING 1905.

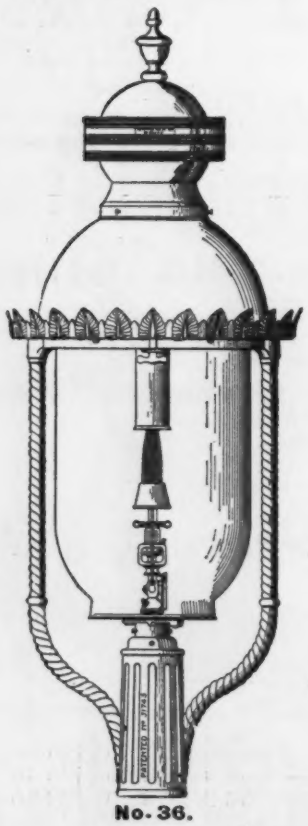
By Table No. 2.

	Hrs.Min.
January	423.20
February	355.25
March	355.35
April	298.50
May	264.50
June	234.25
July	243.45
August	280.25
September	321.15
October	374.30
November	401.40
December	433.45
Total, yr.	3987.45

NEW YORK, 97 Liberty Street.
BOSTON, 814 Beacon Building.
PHILADELPHIA, Broad and Arch Streets.
ST. LOUIS, 712 Roe Building.
CHICAGO, Foot of Orleans Street.
SAN FRANCISCO, 712 Polk Street.

WELSBACH STREET LIGHTING COMPANY

.... OF AMERICA ....



No. 36.

Controls and Operates the

Welsbach System of Street Lighting,

Which includes its specially DESIGNED AND PATENTED BURNER for STREET and PARK LIGHTING exclusively.

Uniformly SUCCESSFUL in 150 Cities and Towns.

By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

POINTS OF MERIT:

It is { Economical, Attractive, Successful, Up-to-date.

IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.

Correspondence Solicited from Gas Companies and Others interested in Municipal and Outside Lighting.

No. 38.

AN underlying principle in business is to show an increase each year---to grow. The astute dealer not only seeks to retain this year's customers, but to attract new trade next year.

The formula is simple---

THIS SHIELD IS THE WELSBACH TRADE MARK.

IT IS A GUARANTEE AND A PROTECTION.

Sell The Welsbach Brands.

The imitation stuff is bad for the customer---which is bad for you.

The genuine Welsbachs---Burners or Mantles---make satisfied customers---keep customers---MAKE NEW ONES.

And your profit isn't merely dollars and cents.

WELSBACH CO.,

Broad and Arch Sts., PHILADELPHIA.

THE UNITED GAS IMPROVEMENT COMPANY

For the Year Ending December 31st, 1904, has been Awarded Contracts for 45 Sets of

Standard Double-Superheater Lowe Water Gas Apparatus.

PARTIAL LIST OF PLACES:

Harrisburg, Pa.
Pelham, N. Y.
Reading, Pa.
Augusta, Me.
Bangor, Pa.
Woonsocket, R. I. (2d contract).
Brooklyn, N. Y. (4th contract).
Cincinnati, O. (2d contract).
Scranton, Pa. (3d contract).
New York City (14th contract).
New Haven, Conn. (2d contract).
Watertown, N. Y.
Tampa, Fla. (3d contract).
Westchester, N. Y. (3d contract).
Bridgeport, Conn. (2d contract.)
St. Paul, Minn. (2d contract).
Springfield, Mass. (2d contract).
Lynn, Mass. (5th contract).
Rochester, N. Y.
Battle Creek, Mich.
Mechanicsburg, Pa.
Excelsior Springs, Mo.
Bristol, Conn.
Jersey Shore, Pa.
Vicksburg, Miss.

TOTAL SETS, 1904,	45
TOTAL DAILY CAPACITY, 1904,	56,325,000 cubic feet.
TOTAL SETS TO DATE,	553
TOTAL DAILY CAPACITY,	419,180,000 cubic feet.

The United Gas Improvement Company,

Broad and Arch Streets, Philadelphia.

Established 1858. Incorporated 1890.
CHAS. E. GREGORY, Prest. DAVID R. DALY, V.-Prest. & Treas.
H. D. ABERNETHY, Sec.

J. H. Gautier & Co.

Greene & Essex Streets,
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CLAY GAS RETORTS, FIRE CLAY TILES,
FIRE BRICK and FIRE CLAY SPECIALTIES.

Ground Fire Clay, Fire Sand and Ground Fire Brick in Barrels and Bulk.

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FLEMMING GENERATOR GAS FURNACE

Brooklyn Fire Brick Works,

OFFICE AND WORKS:
88 VAN DYKE ST., BROOKLYN, N. Y.
MANUFACTURERS OF
CLAY GAS RETORTS & SETTINGS, GENERATOR LININGS. SPECIALTIES.

Established 1854. Incorporated 1869.

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Fire Brick Manufg. Co.,

Manufacturers of { GAS RETORTS . .
FIRE BRICK . . .
RETORT SETTINGS

Water Gas Cupola Linings, Fire Clay, Etc.

Proprietors for the U. S., Coze System of Inclined Benches.

Estimates Furnished on Application for Most Successful Style of Construction.

Also for Free-Firing and Full and Half-Depth Regenerative Benches, for Burning either Coal or Coke in the Furnaces.

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Cor. Manchester and Sulphur Avenues, St. Louis, Mo.

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Formerly with the Continental Iron Works.
Draughtsman and Constructing Engineer.
Drawings, Specifications and Estimates furnished for the construction of new works or alteration of old works. Special attention given to Patent Office drawings.
Office, No. 245 Broadway, N. Y. City.

FIELD'S ANALYSIS FOR THE YEAR 1903.

An Analysis of the Principal Gas Undertakings in England, Scotland and Ireland. Being the 35th year of publication. Compiled and arranged by JOHN W. FIELD, Sec'y and Gen. Mgr. of The Gas Light and Coke Company, London. Price, $5. For Sale by
A. M. CALLENDER & CO., 42 Pine St., New York City.

Adam Weber Sons.

GENERAL OFFICES: Park Row Bldg., N. Y. City.
DEPOT & WAREHOUSES: 639 E. 15th St., N. Y. City.
WORKS: Weber, N. J.

ERECTION OF

Modern Coal Gas Plants,

With either Horizontal, Inclined or Vertical Retorts.

PATENTS APPLIED FOR.

No. 1. Firing horizontal benches with pulverized fuel, with either 8 or 10 retorts in 1 setting, using one furnace for two benches. Great saving in labor, fuel and life of retorts and settings. No elaboration of complex recuperation.

No. 2. Independent retort settings, taking all weight from retorts.

No. 3. Vertical retorts with vertical charge and discharge. Sixteen retorts in one bench.

MODERN BENCH IRONWORK.

ISAAC C. BAXTER, President. ESTABLISHED 1864. PETER YOUNG, Secretary and Treas.

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LOCKPORT STATION, PA.

JAMES GARDNER, JR., CO.,

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Successor to WILLIAM GARDNER & SON.

Fire Clay Goods for Gas Works.

HENRY MAURER & SON,

(ESTABLISHED 1856.)

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RETORT WORKS

WORKS, Perth Amboy, N. J.
OFFICE, 418 to 422 East 23d St., N. Y.

Clay Gas Retorts,
BENCH SETTINGS,
Fire Brick, Tiles, Etc.

GEROULD'S IMPROVED RETORT CEMENT

A Cement of great value for patching retorts, putting on mouthpieces, making up all bench-work joints, lining blast furnaces and cupolas. This cement is mixed ready for use. Economic and thorough in its work. Fully warranted to stick.

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In Casks, 400 to 800 pounds, at 5 cents per pound.
In Kegs, 100 to 200 " " 6 " "
In Kegs less than 100 " " 7 " "

C. L. GEROULD, BLOOMINGTON, IND.

For orders East of Buffalo, N. Y., or Pittsburg, Pa., freight will be paid to these points.

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PRESSURE GAUGE.

For continuous records of Street Gas Pressure.
Simple in construction, accurate in operation and low in price.
Fully Guaranteed. Send for Circulars.

THE BRISTOL CO.,
Waterbury, Conn.

Silver Medal, Paris Exposition.

GASHOLDER TANKS AND GAS WORKS MASONRY COMPLETE.

Plans prepared and Estimates furnished at short notice.

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THEO. J. SMITH, Prest. J. A. TAYLOR, Sec.
A. LAMBLA, Vice-Prest. and Supt.

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RETORT & FIRE BRICK CO.

MANUFACTORY AT
LOCUST POINT, BALTIMORE, MD.

Clay Retorts, Blocks & Tiles

FIRE BRICK, FIRE CLAY, AND FIRE CEMENT.

Our Improved Half and Full Depth Benches have been Adopted by Many Gas Companies.

WALDO BROS., 102 MILK ST., BOSTON, MASS.
Sole Agents for New England States.

JOHN DELL,
President and General Manager.

MISSOURI FIRE BRICK CO.,

ESTABLISHED 1882.

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Gas Retorts, Bench Settings, Fire Brick, Cupola Linings, Etc.

We are the **Exclusive Agents** *for the* **Mitchell Patent Benches,** *Constructed with Half or Full Depth Furnaces, to Burn either Coal or Coke, and Arranged for Front or* **Rear Clinkering.** **The Mitchell** *is the* **Original Coal Firing Bench.** *We also Erect Plain Benches with* **One** *to* **Six Retorts.**

YOUR CORRESPONDENCE IS RESPECTFULLY SOLICITED.

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411 Olive Street, Continental Bank,
ST. LOUIS, MO.

Bronder Patent Stoking Machinery.

Three-Scoop and Three-Rake Charging and Discharging Machines are operating in New York, Newark, N. J., Philadelphia, Worcester, Mass., Mt. Vernon, N. Y., Toronto and Montreal, Canada.

Four-Scoop and Four-Rake Charging and Discharging Machines are operating in Detroit, Mich.

These are the only machines that will draw or charge simultaneously 3 or 4 retorts (vertically) and handle from 42 to 60 retorts in from 25 to 30 minutes, lid opening and closing and filling of furnaces included.

Hot Coke Conveyor, Quencher and Steam Exhauster, operating in Toronto, Canada, working in water-sealed flue, rollers being protected from heat and grit.

COAL CRUSHERS, CONVEYORS AND BINS. TURNTABLES FOR MACHINES.

Labor-Saving Machines for Handling Coal and Coke from Coal Cars to Coke Yard or Bins, a Specialty.

G. A. BRONDER,

Contracting Engineer and Builder,

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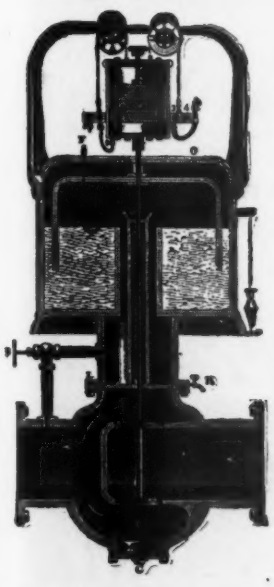
CONNELLY IRON SPONGE AND GOVERNOR CO.,



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DESIGN, CONSTRUCTION AND EXTENSION

— OF —

COAL AND WATER GAS PLANTS,

AUTOMATIC BALANCE, HIGH PRESSURE AND SERVICE GOVERNORS,

ROOTS' IMPROVED EXHAUSTERS.

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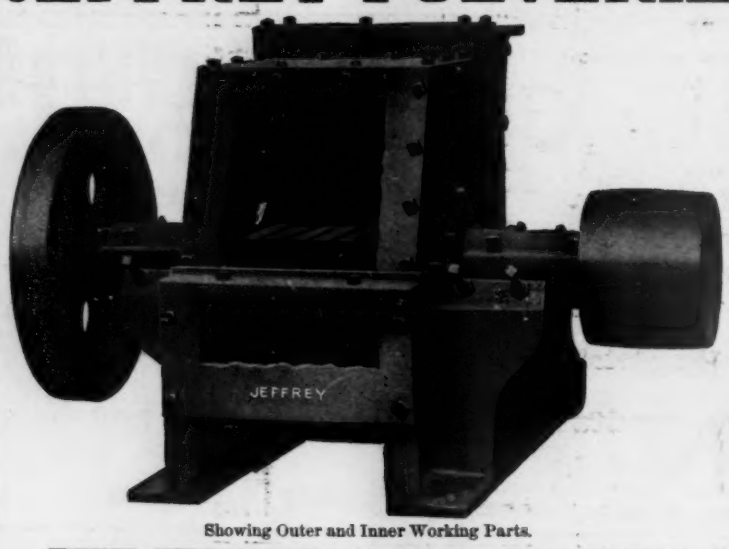

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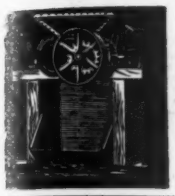

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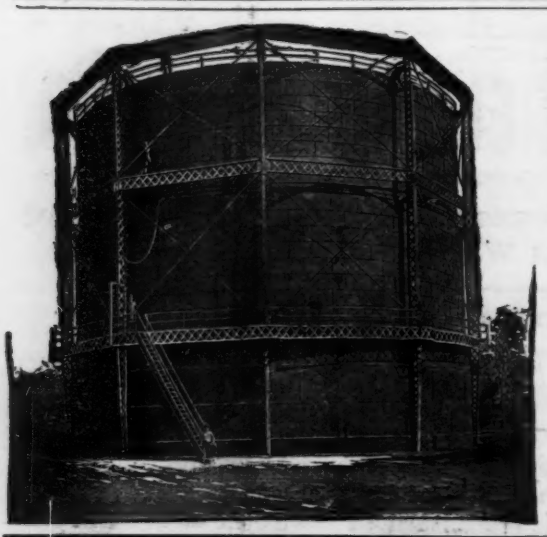

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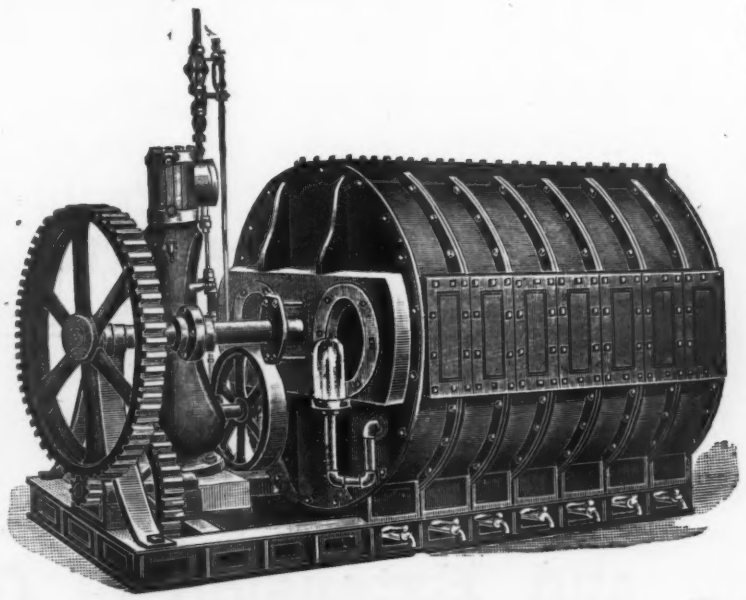

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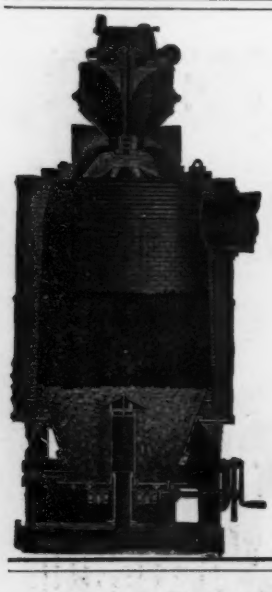

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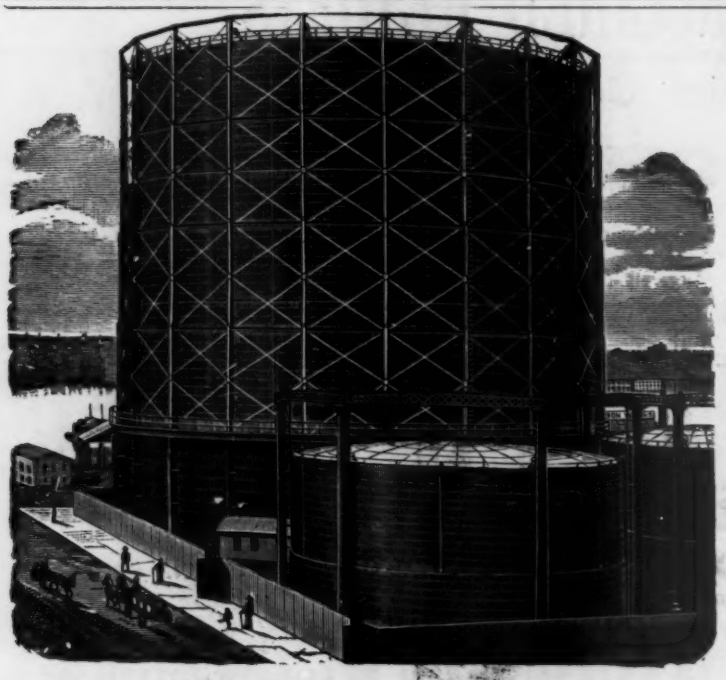

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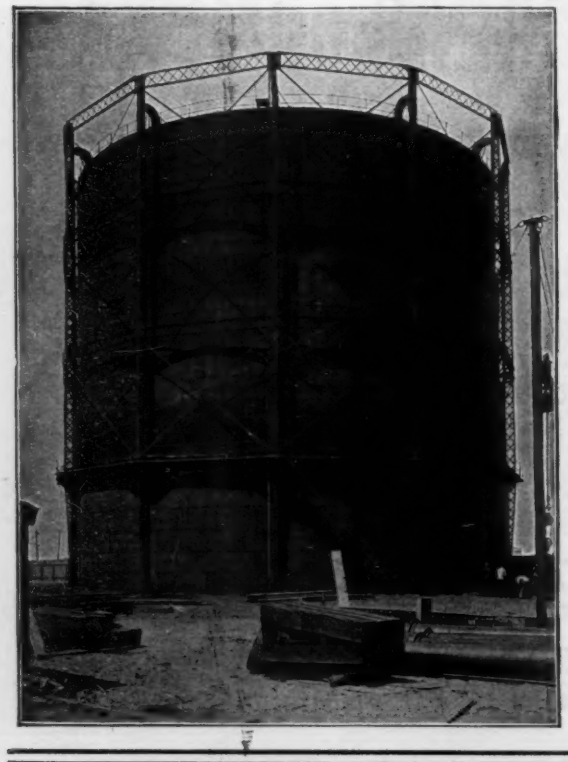

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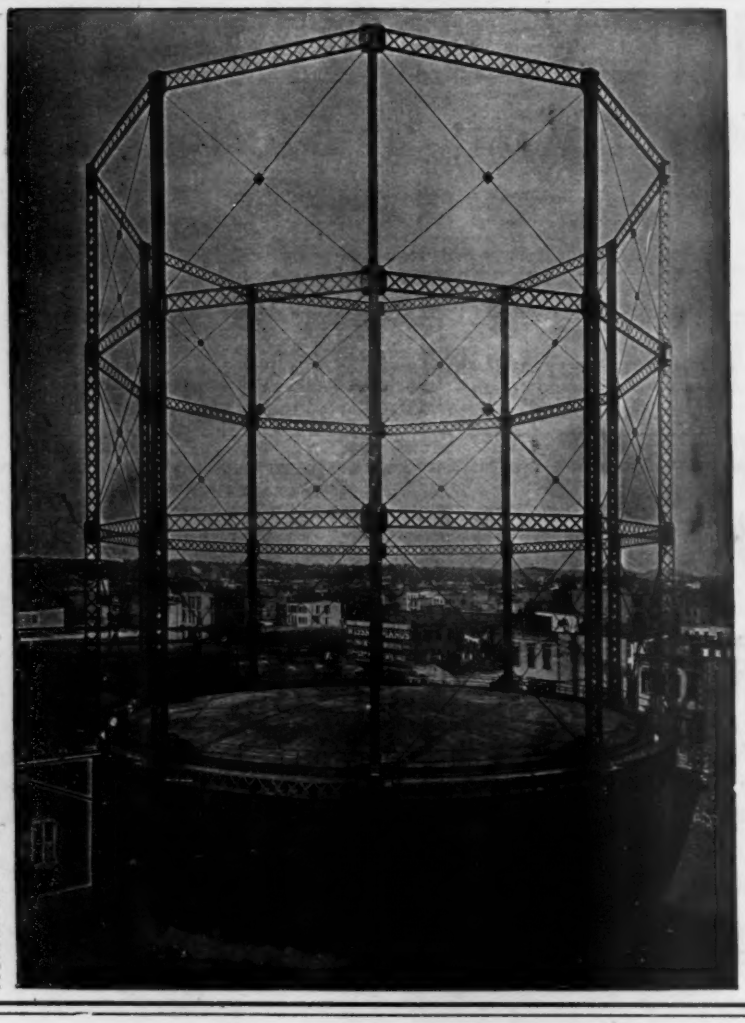

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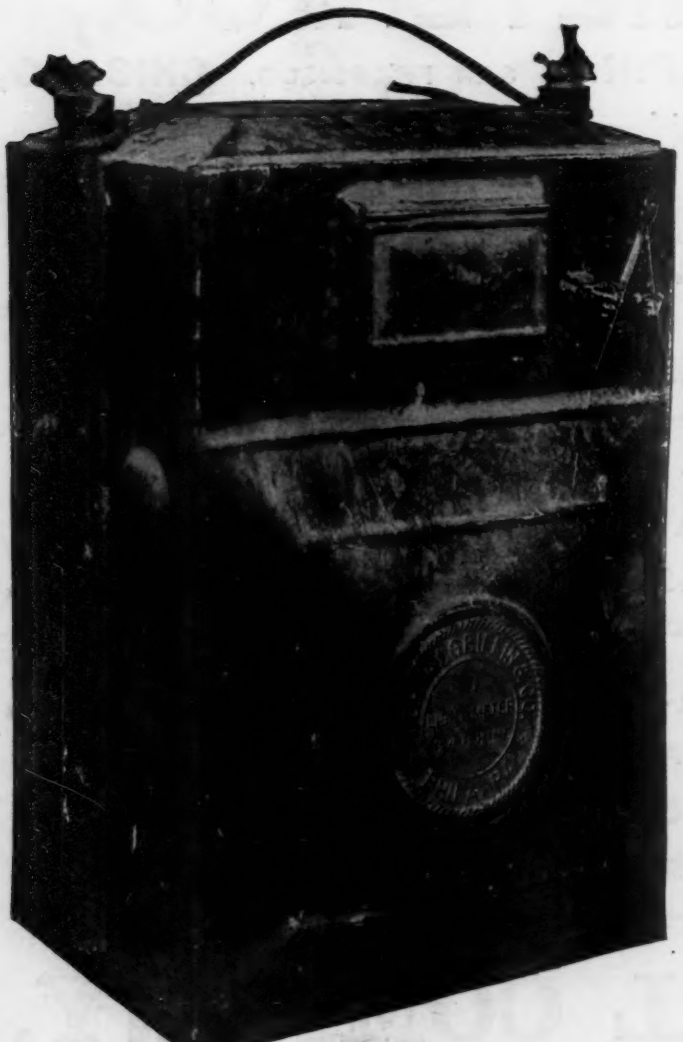

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